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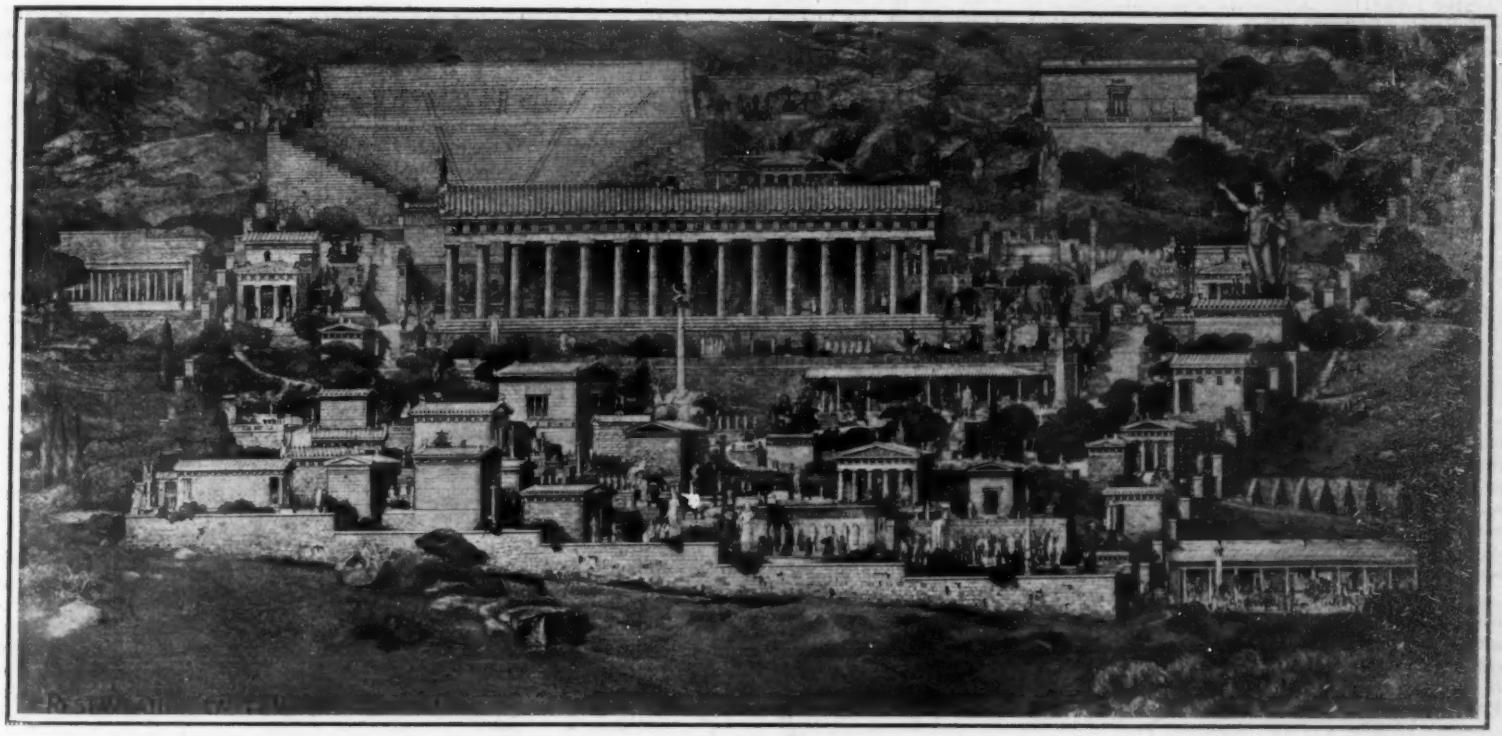
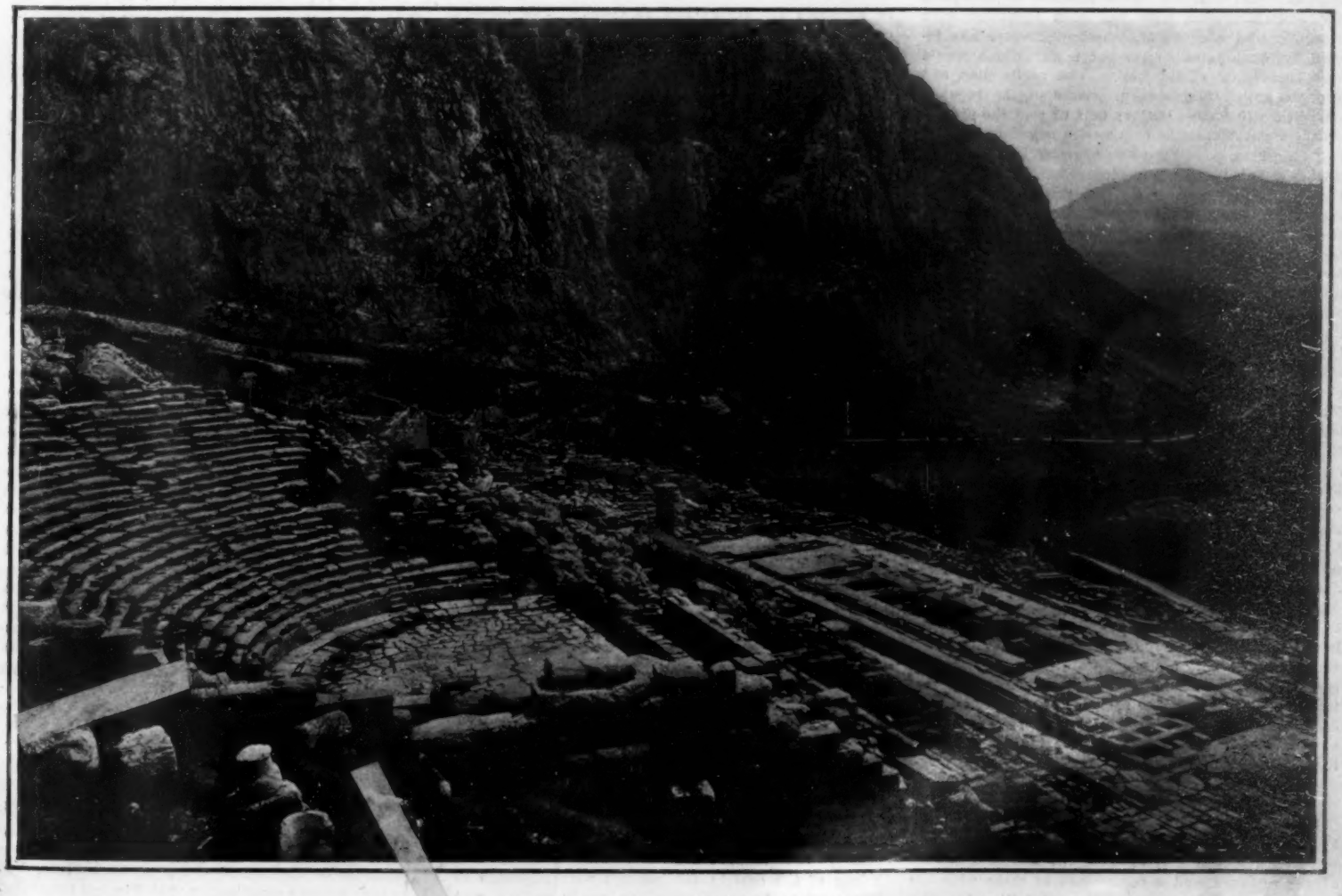


The Temple of Apollo as restored by Homolle.



General view of the theater and Temple of Apollo.

RECENT EXCAVATIONS AT DELPHI.—[See page 373.]

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NEW YORK, SATURDAY, MAY 15th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A LONG-DELAYED TRIBUTE.

On Wednesday, April 28th, a fitting tribute was paid in the city of Washington to the man to whose genius is due the present and prospective beauty and dignity of the nation's capital. On that day the remains of Major Pierre Charles l'Enfant were transferred from an abandoned family burial ground on a Maryland farm to their present resting place in the National Cemetery at Arlington. The ceremonies were of a simple character. The body, draped with the national flag, was placed in the rotunda of the Capitol, where a service, attended by the President and Vice-President, the French Ambassador, and a large audience composed of members of both Houses and of the diplomatic corps, was held, after which the remains were carried under military escort to the Arlington burial ground and there interred. No stronger evidence could be given of the need for this national recognition than the fact that the majority of the people of the United States are probably ignorant alike of the name of Major l'Enfant and the important work which he accomplished. It is to l'Enfant that we owe the excellent plan upon which the city of Washington was originally laid out. At the suggestion of Jefferson, this French soldier, who had been identified with Lafayette in the cause of American liberty, was invited by Washington to lay out a city which would form the capital of the nation, and in its plan and scope be suited to the requirements of the republic for all time to come. History tells us that the present scheme was the outcome of a week's sojourn at Mount Vernon, where, with the plans of several cities of the old world before them, President Washington and his French engineer worked out, at least in their broad outline, the plans of the capital approximately as we now know it. It has been asserted that in constituting the Capitol and the White House the two centers for the series of radiating avenues, l'Enfant probably had in mind the plan of Versailles. Whatever the origin of the present plan, there can be no doubt about its success; for, when in connection with the celebration of the centennial of the city, in 1900, a commission of prominent American architects was sent abroad to study the plans of the most beautiful of European cities, they indorsed l'Enfant's plan, and based their recommendations upon its general outlines. Unfortunately, after the work of construction commenced, there was disagreement between the French engineer and the building committee, and he was removed. In spite of President Jefferson's recommendation that he be paid from $2,500 to $3,000 for his services, it was not until 1810 that he was voted $666.66, with interest from 1792, for the work he had done. He was invited by a Mr. Digges to his farm in Maryland, and, after spending some twenty-five years of his life there, he died and was buried in the family burial ground of the Carrolls and Digges. Here the body remained for nearly a century until its recent removal to Arlington. To make this tardy recognition of the important services of the designer of our capital city complete, it will certainly be in order for the nation to erect a suitable memorial above his present resting place.

OUR STUPENDOUS RAILWAY SYSTEM.

In view of the fact that the welfare of the country is so intimately related to the vast system of railways with which it is covered, the annual statistics of our railways, and a comparison of these with the records of earlier years, are of never-failing interest. We have before us the railway statistics of this country as prepared by Mr. Slason Thompson, of the Bureau of Railway News and Statistics, in which the standing of our railways for the year 1908 is compared with their condition in the two previous decades.

At the close of the fiscal year 1908, the total number of miles of lines in the United States was 230,000, as compared with 136,883 in 1888 and 184,648 in 1898. The net capitalization is $13,000,007,012, an increase of 39.8 per cent over the figures of 1898. The gross earnings for 1908 of $2,448,835,000 were nearly double those of 1898. Ten years ago, the total number of passengers carried one mile was about 13.3 billions. In ten years' time this has increased over 120 per cent, reaching a total of 29.5 billions. A marked increase has taken place in freight traffic; for whereas the number of tons of freight carried one mile in 1898 was over 114 billions, last year it was over 122 billions. The passenger revenue per passenger mile, which in 1888 was 2.49 cents, in 1898 had decreased to 1.973 cents and in 1908 to 1.933 cents. In the decade from 1888 to 1898 there was a decrease in freight revenue from 1.0 cent per mile to 0.753 cent, at which latter figure it also stood in 1908.

Very significant of the growth of our railroads is the great increase in the number and weight of locomotives and cars. Ten years ago, the total number of locomotives was 36,234. During the last decade there has been an increase of 57.7 per cent to a total of 57,156 locomotives. Even more remarkable has been the increase of 115.3 per cent in the total weight of the locomotives. The number of passenger cars has increased from 33,595 to 44,622. The number of freight cars has risen from 1,248,826 to 2,130,110, an increase of over 70 per cent, but their capacity has increased over 120 per cent, from over 32,000,000 tons to over 71,000,000 tons. In 1898 the total number of employees was 874,558. Last year the total was 1,451,000, an increase in the ten years of over 67 per cent. During the year there was paid out in compensation to employees over $1,000,000,000, which is an increase of 110 per cent over the amount so paid out in 1898.

Figures such as these tell most eloquently the story of the phenomenal development of the country during the past decade. That the prosperity of the railroads is intimately associated with that of the whole country is proved by the fact that in the twelve months that followed the panic, the railways suffered a loss of over $330,000,000 in gross earnings.

COMPARATIVE TESTS OF THE SCOUT CRUISERS.

We have delayed making reference to the endurance tests of the scout cruisers "Chester," "Salem," and "Birmingham," in the hope that the official figures would be made public. Recent developments, however, make it unlikely that these results will be available for some time to come. The unofficial reports of the trials show that the comparative efficiency of the turbine and reciprocating engine is about what would be expected. The "Birmingham" with her reciprocating engines showed superior coal economy at the lower speeds. At the higher speeds the "Chester," equipped with Parsons turbines, gave the best results. Altogether, the honors of the trials lie with the "Chester," the "Salem" with her Curtis turbines proving to be, for reasons which did not develop until after the trial, a great disappointment. In the 24-hour sea speed test at full power, the "Chester" steamed 601.92 nautical miles at an average of 25.08 knots, while the "Salem" covered 588.96 knots at an average speed of 24.54 knots. The coal consumption of the "Chester" was 415 tons and of the "Salem" 420 tons. The "Birmingham" broke down under the severe strain, and her failure illustrates once more the unreliability of the reciprocating naval engine when driven continually under maximum power at the highest speed. It is mainly the mechanical simplicity of the turbine, and its well-proved reliability when pushed to the limit of its power, that have made this type of engine so popular with naval men.

Some months prior to these tests, the government carried out another series of tests under similar conditions, in which account was taken, not of the fuel but of the water consumption. Water consumption tests are the true criterion of an engine's economy, since they eliminate the question of boiler room efficiency, which may easily vary from 10 or 15 to 20 per cent because of the more intelligent firing on one ship than on the other. In these water tests at all speeds from ten knots to twenty-five, the two types of turbine, Parsons and Curtis, are reported to have shown about the same efficiency. On the recent endurance tests, however, the "Salem" exhibited at the lower speeds a far higher coal consumption, and a greater consumption, as stated above, at the highest speeds, though here the difference was much less. In explanation of her comparative failure, it is stated by the engineers of the "Salem" that the method of measuring coal by painting white stripes around the bunker walls, and estimating the amount of coal consumed by the height of the coal in the bunkers with reference to these stripes, is a very rough-and-ready method, and may give inaccurate results; the amount of coal, as thus measured, depending upon the solidity or otherwise with which it is packed at the time it is taken aboard. Although this does not by any means prove that the "Chester" was favored, it certainly vitiates the value of the results. It is also urged that the skill of the firemen might easily make a big difference in the coal consumption, favoring one vessel or the other, as the case might be. There is another explanation of the high coal consumption of the "Salem," which appears to us to be of much more weight. On the high-speed, all-day run it was found that the starboard turbine was running about fifteen revolutions slower than the port turbine; and the conviction of the engineers of the "Salem" that something must be wrong was verified when the casing was opened up and it was found that a bolt, which had somehow found its way among the blading, had badly disarranged the latter.

In view of these facts, we think that, when the injury to the "Salem's" engines has been repaired, these competitive trials should be run over again, but this time on a more thorough and scientific basis. The boiler and engine-room staff of every ship should be thoroughly trained, until it is perfectly familiar with the plant. The coal should be carefully weighed as it goes into the bunkers; care should be taken that it is similarly stowed in each ship; and both the fuel and the water consumption should be recorded. We are well aware that to carry out another series of trials along these lines would be costly; but in view of the enormous importance of the issues at stake, the money would be spent to good advantage. In spite of the good showing of the reciprocating engine at cruising speeds, it is certain that our future warships must be engined with the turbine. Hence the importance of making a wise choice between the Parsons and the Curtis type. Standardization is of prime importance in naval construction, and there should be but one type of turbine in all the ships of the future. The Parsons turbine may well stand upon its splendid record—a record which has been enhanced by the excellent results achieved by the "Chester" in the recent trials. Its younger rival, the Curtis turbine, however, has advantages of a military character, which commend it strongly to naval men. Moreover, in the latest turbines of this type tested in Germany, water consumption economy has been obtained which exceeds anything yet achieved by any marine turbine. For these reasons we consider that it is incumbent upon the Navy Department to use the opportunity presented by the scout cruisers for another and more satisfactory series of tests.

RETURN OF THE WRIGHT BROTHERS.

The sudden rise of the Wright brothers from the obscurity of the struggling inventor to international fame and no small measure of wealth has in it a strong dash of the romantic. The exploits of these two Americans during the past eight months have placed our country far in the van of other nations in the art of flight with heavier-than-air machines. Starting with the first public exhibitions in France and America, which were made simultaneously by Wilbur and Orville Wright, respectively, last September, the career of the former of the two brothers especially has been practically a continuous ovation. First at Le Mans, where on December 31st he made an unparalleled flight of nearly 100 miles in 2 hours and 20 minutes; later at Pau and Rome, where he taught several pupils how to operate the aeroplane in a dozen 15-minute lessons each, Wilbur Wright has been lauded in the highest terms, and has been the recipient of distinguished attentions from the most prominent rulers of European countries. Orville Wright, since his accident at Fort Myer, has not made any flights; but he is, we understand, to resume the carrying out of the very difficult government contract next month. This involves a 10-mile cross-country flight across a deep valley, which is something the like of which has never been accomplished even by Wilbur Wright during all the 3,000 miles he has flown abroad, although he has at times risen more than 350 feet in height tests over smooth ground. In cross-country flying, however, both Farman and Bleriot so far hold the records.

The idea of selling aeroplanes to governments, which these two inventors had in mind when they went abroad, seems to have succeeded almost beyond expectations. Italy, Germany, Russia, and England have either purchased or negotiated for aeroplanes, while in France the selling of the patent rights to a syndicate has made possible the rapid introduction of the machine.

After completing the contract with our own government, which will be done next month at Fort Myer, the inventors intend to make further experiments looking toward the perfecting of an automatically stable aeroplane.

Members of the Signal Corps at Fort Myer, Va., have been making experiments with wireless telephony. They have succeeeded so far in communicating over a distance of five miles. The government has appropriated $30,000 for experimental work of this sort.

ENGINEERING.

The number of persons killed in train accidents during the months of October, November, and December, 1908, as reported to the Inter-State Commerce Commission, was 184, and the number injured 2,924. Accidents of other kinds, including those sustained by employees while at work, and by passengers in getting on or off cars, etc., bring the total number of casualties up to 17,644 (798 killed and 16,846 injured).

It is announced by Secretary of the Navy Meyer, that the voyage of the sixteen battleships around the world involved an outlay of only $1,500,000 more than would have been necessary had the fleet spent the time occupied on the voyage in home waters, either at anchor, or cruising, or engaged in the customary manœuvers. We quite agree with the Secretary that the investment of this sum by the government was one of the most fortunate and successful that could have been made.

The record for canal excavation at Panama for a single month was again exceeded during March last, when 3,880,337 cubic yards were removed. This amount exceeded that of March, 1908, by 393,050 cubic yards. Of the grand total, 2,352,903 cubic yards were removed by steam shovels, and 1,527,434 cubic yards by dredges. The average daily excavation was 143,716 cubic yards, which was nearly 7,000 yards more than the highest previous record, made in February last.

The arrival of the 17,000-ton ocean liner "Lapland" marks the completion of the first trip of a new Red Star liner, and the addition of one more to the already large fleet of ships of great size plying between New York and Europe. The vessel is 620 feet long, 70 feet broad and 50 feet in depth. In addition to a double bottom and eleven water-tight compartments, she is provided with a center line bulkhead for additional safety. She will accommodate 450 first-class, 350 second-class, and 1,500 third-class passengers, and carries also a crew of 450 men.

A refinement in yacht construction, introduced last year by Fife in the construction of "Shamrock," consists in the substitution of a thin slip of wood, known as a "slip feather," for putty, in stopping the seams after they have been calked. The "feather" is covered with a very tenacious glue, driven hard home into the seams, and left to dry. After the sides are planed off, a remarkably smooth surface is obtained, the skin of the vessel being to all intents and purposes in one piece. This method has the further advantage that there is no calking to work out when the vessel is being heavily strained.

The maiden voyage of the new White Star liner "Lorentic" from Liverpool to Montreal was watched with the greatest interest by the maritime world, because of the fact that she is the first ocean steamship of great size to contain in her engine room a combination of reciprocating and turbine engines. The equipment consists of two reciprocating engines, driving the wing propellers, and a turbine driving the central propeller. The ship is 565 feet in length. A sister vessel, the "Megantic," will make her first voyage early in June. The "Megantic," however, is driven by twin-screw, reciprocating engines. On the comparative results obtained by these two vessels will largely depend the character of the motive power employed in the two new White Star steamers now building, the "Olympic" and "Titanic."

Since July of last year, there has been in service on Long Island Sound a motor boat driven by a 25-horse-power marine gas producer. The plant is very compact, the special design of scrubber being only one-quarter the size of the generator, whereas, according to International Marine Engineering, from which the following facts are taken, the scrubber is usually about twice as large as the generator. The boat has given good satisfaction in all kinds of weather. The consumption is from one to one and a quarter pounds of coal per horse-power. In a ten-hour run, the cost of fuel at $6 per ton is 94 cents. The same size motor, operating on gasoline, would consume for the same work $3.50 worth of fuel. The gas producer occupies a space of four feet by six feet; its height over all is five feet; and the total weight is twelve hundred pounds.

The action of the Public Service Commission in ordering the construction and operation of subway cars provided with two doors at each end of the car has stirred up the officials of the Interborough Company to construct and put in operation a train of cars of their own design having single end doors and a wide center door. The Public Service officials claim that better results are obtained with the double-end-door type, while the company believes that the center door gives speedier service. It seems to us that in both types sufficient effort is not being made to secure a circulation of passengers by reserving one set of doors for entrance and the other for exit. At present, the public are allowed to use all doors for entrance and exit, as they please.

ELECTRICITY.

A novel device has been invented for use in hotels, to enable the patrons to determine the exact time at any hour of the day. A small telephone receiver is connected to the head of the bed in each room, and may be placed under the pillow, if desired. The device is connected to a master clock. When the sleeper wishes to know what time it is, he places the 'phone to his ear and presses a button. A set of gongs will then strike the hour, the quarter, and the number of minutes past the quarter.

In the textile industry it is customary to remove the small fibers of a thread by passing it through a gas flame. The main objection to this method is that most of the heat is wasted, and the products of combustion are injurious to the workmen. To overcome these disadvantages, an electrical singeing apparatus has recently been devised. It consists of a tube of platinum, which is slotted at one side to permit of introducing the thread. The tube is heated by heavy current of low voltage. The products of the combustion are drawn off by an aspirator.

It is somewhat difficult to control the temperature of an electrically-heated flatiron, owing to the fact that when in use it is chilled by contact with damp goods, while at other times it is apt to be overheated. This difficulty is overcome by a recent invention, which provides a thermo-electric control. When the flatiron is in use, a large amount of current is permitted to pass through the heating coils, but whenever the heat rises unduly, a switch automatically introduces the resistance necessary to cut down the current.

The North-Eastern Railway of England has just introduced an electric baggage car, designed to carry both parcels and fish. There are four compartments in the car, one at each end for the motorman, while the body of the car is divided at the center to form the separate luggage and fish compartments. A novel feature of the car is the arrangement of the couplers, there being three at each end. The center one is used for coupling to electrically-driven trains, while the two couplers at each side are required for coupling to a steam-driven train. The car is provided with four 125-horse-power motors.

According to a recent consular report, the telegraph offices in Japan numbered at the beginning of this year 3,308, and the lines were 5,387 miles long, with a total length of wire 92,227 miles. Nearly 8,000,000 telegrams were handled during the year. All the naval vessels are equipped with wireless telegraphy, and some successful experiments have been made with the wireless telephone. The system of wireless telegraphy used is known as the Teishinsho, which is said to differ from the Marconi and De Forest systems. Most of the Japanese steamships on foreign lines are equipped with wireless telegraph apparatus.

The congestion of traffic around the new Union Station in Washington has made it necessary to provide special signaling systems for the trolley cars running to this point. The problem, which was quite a serious one, has now been solved by the use of switch and signal towers at the important switching points. These towers are ornate structures, consisting of small cabins mounted on posts and raised about 8 feet above the sidewalk so that the switchman has a clear view of the car lines. The signals consist of colored lights placed under grated openings in the car tracks. An interlocking switch and signal system is employed to prevent mistakes on the part of the switch operator. The signal will not show clear until the switch has been properly thrown, and thereafter the switch lever cannot be operated until the car crosses over the signal.

A recent number of the Electrical World contains an interesting suggestion, by which the distance and direction of a wireless sending station may be determined. It will be remembered that at the time of the collision between the "Florida" and the "Republic," the "Baltic," although but 65 miles away when first it received the signals of distress, was unable to find the "Republic" for twelve hours, during which time it had steamed over a course of 200 miles. Had there been some method of determining the position of the "Republic," the distance could have been covered in four hours. The method suggested by the writer in the Electrical World is based on Duddell's rule that the distance between the transmitter and receiver multiplied by the strength of the incoming current is a constant. If the "Baltic" had noted the increase or decrease of current while proceeding in one direction as compared with the variation when proceeding on another course, she could theoretically have figured out the exact location of the sinking vessel. While in practice it would be much more difficult to locate the exact position of the sending station by this means, owing to the variations due to other conditions, an approximate position might be calculated, which would undoubtedly be better than none at all.

SCIENCE.

It is reported that a syndicate prospecting 150 miles south of Suez, on the Red Sea coast, has struck oil, the gusher giving increasing quantities daily, and indicating large reserves. The possibility of a cheap supply of fuel is a discovery of the greatest importance to Egypt.

An attempt is to be made to acclimate the Korean wild fig in California. The fig, growing on a hardy vine, on trees, trellises, and hedgerows to a height of 30 feet, bears a delicious fruit. Some of the seed has been sent to the Department of Agriculture, California State University. The fig grows wild in Korea, and has proven of great value there.

Walter Wellman announces that he will renew his efforts to reach the North Pole by means of his dirigible airship this summer. Capital has been supplied by Americans. The general plan of the expedition remains as it was. In other words, the airship will be assembled and inflated at the headquarters station, Danes Island, Spitzbergen, and will proceed northward some time in August.

Dr. H. O. Beeson states that a very common and entirely avoidable cause of indigestion is the use of common salt in excess. Salt, if used in the proportion of 4 parts or less to 1,000, is beneficial to digestion, but beyond 6 parts to 1,000 it is positively harmful. Our daily average consumption is approximately 22.5 parts to 1,000, whereas sea water contains only about 27 to 1,000. Our daily army ration contains 307 grains of salt, of which only 15 are assimilated.

On May 1st the Delaware, Lackawanna & Western Railroad installed on its through trains a system of supplying water to passengers which must commend itself to those who have the public health at heart. In every car a slot machine is installed, which supplies paraffine drinking cups for 1 cent apiece. The passenger uses this paraffine vessel, and throws it away after use. The principle of the scheme is so good, and its advantages so obvious, that they need not be dilated upon.

In order to test whether or not his apparatus for the prevention of mountain sickness is a success, Prof. David P. Todd will conduct experiments in ballooning. It is Prof. Todd's idea to establish on some lofty peak an astronomical observatory, in the clear atmosphere of which it will be possible to make better astronomical observations than are now obtained. To carry out that idea, he intends first to ascertain whether or not mountain sickness can be prevented at elevations exceeding 6,000 feet. He has devised a special apparatus for supplying compressed air which he hopes may attain the object.

Misuse or excessive use of the X-ray is made the subject of a scathing criticism by Dr. Gordon G. Burdick of Chicago. The average X-ray operator in his opinion is thoughtless and careless to a degree, and one who will bear the marks of his blind enthusiasm to the grave. To see many of the electricians who have lived in the atmosphere of the X-ray laboratory is to see a living death personified. The tissues become corroded, and life is bearable only under the influence of opiates. It is sad to think that these men cannot plead ignorance, and that they have sadly and wantonly abused the supreme diagnostic agent of modern medicine.

The effect of earth shine upon the moon is a familiar one to many people, though probably few of them know the cause of the effect. When the moon is in its first quarter the dark portion of it is often faintly visible. The bright quarter is, of course, illuminated by direct sunlight, but the remainder is only seen by virtue of the faint light reflected from the earth. This faintly illuminated portion has been successfully photographed by M. Quénisset at the Kuvisy Observatory, and it appears likely that the results will present many points of interest to astronomers. The light received from the earth naturally falls at a different angle from that at which light is received from the sun, therefore it is reasonable to expect a slightly different effect of light and shade on the irregularities of the moon's surface.

Prof. H. H. Turner, F.R.S., of Oxford, England, in a recent paper refers to the number of earthquake observatories which have been constructed and equipped with delicate instruments that can detect and record the tremors of the earth's crust very exactly in regard to time and extent. From these records it appears that there are every thirty years some thirty thousand minor shakes of the earth in different localities. Of all these only sixty are world shaking and observable at a great distance. The Italian earthquake some months ago was one of this class. In speaking on the distribution of earthquakes, their periodicity and of their prediction, Prof. Turner states that "a shifting of the earth's axis, even to the slightest degree, would impose a great strain on some parts of the earth's crust, and this might explain earthquakes and in turn lead to appreciable results in foretelling them."

CORK-LINED FABRIC—A TEXTILE NOVELTY.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A new fabric has been brought out in France, known as Tissu-Liege, or cork tissue, and it is now manufactured on a commercial scale. Cork, cut in very thin layers and treated so as to be quite flexible, is applied to almost any kind of woven fabric for this purpose. In this way a fabric is obtained which is quite waterproof, and very light, odorless and comfortable in general. It is designed specially to take the place of rubber cloth and to overcome the numerous disadvantages of the latter.

A COAT MADE OF CORK-BACKED FABRIC.

The cloth fabric is faced with the thinly-cut cork upon one side only, leaving the outer side of the usual appearance. If desired in certain cases, the cork layer is placed between two layers of cloth. In the process of manufacture the cork is given a preliminary treatment by which it is freed of its resinous matter. It becomes quite flexible and is cut into very thin sheets. A sheet is placed upon the fabric and is tightly pressed upon it. Any of the usual fabrics can be used with the cork layer, cotton, wool, silk, ramie, jute, and others. The operation does not change any of the properties of these fabrics nor their external appearance. Felt as well as leather can be employed in this way.

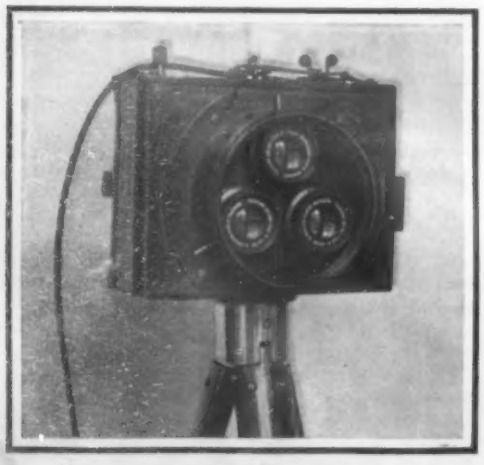
The fabric thus cork-lined does not deteriorate in the course of time, which is the case with rubber cloth. It is well known that rubber, especially in thin layers, quickly deteriorates and after a time becomes brittle and cracks, thus losing its waterproof character. Because of the lightness of the cork, a garment made of Tissu-Liege is scarcely over half a pound heavier than the same when untreated. Those who feel the weight of rubber cloth garments will see this advantage at once. It might be thought that the cork could not be supple when thus applied, but in reality it is made as supple as cloth; for the cork is treated so as to be quite freed from the resinous bodies which make it brittle, and is cut in very thin layers of 1/10 millimeter (1/250 inch). It is somewhat surprising to see that such a cork fabric can be bent and folded down without the slightest sign of breaking, and in fact the cork is now as flexible as cloth, owing to the extraction of the resinous parts.

A NEW COLOR-PHOTOGRAPHY PROCESS.

DESCRIPTION OF A NEW CAMERA FOR TAKING AND PROJECTING PHOTOGRAPHS IN NATURAL COLORS.

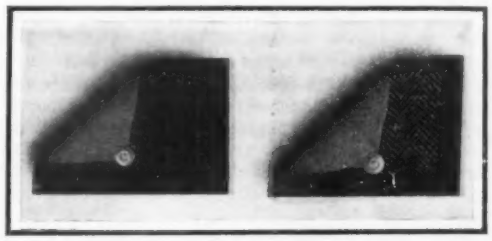
Amateurs would no doubt use much oftener the three-color process for obtaining views in natural colors were it not that there is a considerable complication in carrying out the method as it is employed at present, at least when we compare it with ordinary photography. When well handled, the use of the three screens for color photography will give very pleasing results, and these are well worth the pains which are spent in this way. However, there is not only the difficulty in taking the three exposures with the color screens, but after the plates are obtained they must be matched exactly in order to secure the proper combined effect. On the other hand, owing to the introduction of the new autochrome and similar plates for taking photographs in colors upon a single plate, it is to be feared that the three-color process will be abandoned unless there is some more simple means found for carrying it out. This seems to be the case, however, with the apparatus devised by M. André Chéron, of Paris.

What is characteristic of M. Chéron's apparatus is that it not only takes the three views upon a single plate and in one operation, but that it also serves, after the plate has been obtained, for projecting the views upon a screen, as would be done in a stereopticon, so that we can observe the views in their natural colors and greatly enlarged, without taking much more trouble than is found with the use of an ordinary camera. For this purpose he employs a camera of small size like that illustrated herewith, and makes use of three lenses of the same kind, one for each of the red, yellow, and blue color screens. These screens are properly graduated in color beforehand so as to secure the proper effect. The lenses are of the fixed focus type such as are used in the non-focusing kodaks. In the rear of the camera is an ordinary plate holder. The plate used is large enough to take all three images from the three lenses, and owing to the reversed effect there are thus two images at the top of the plate and one at the bottom. As the images given by the lenses are less than two inches in diameter, all three of them can be taken upon a 4 x 5-inch plate, so that the camera is of small and portable size. A shutter of the rolling curtain type is mounted next to the plate and allows of making the exposures. The color screens are adjusted with the lenses so that the exposures for the three lenses can be made at the same time. After exposing the plate, it is developed, and from the negative a positive or lantern transparency is made in the usual way, so that it also contains the three images in black and white. For making the projection on the screen in natural colors, the transparency is placed in an open slide or plate holder and put in the position occupied by the original plate. A lamp, such as a Welsbach burner or other good light, is placed back of the camera so that the beams of light pass through the plate and out through the lenses. These, as already stated, are of the constant-focus type, that is, they are focused only for parallel rays coming from the distant object, and such rays are brought to a focus on the plate. If now the light be sent through the image, this light will be divergent at first, but upon reaching the lens the rays will be brought to a parallel beam such as the lens received from the distant object in the first place. Such rays therefore will not be concentrated on the screen placed in front of the camera. Taking the case of a single image and its lens, the parallel rays given out from the lens can be brought to a focus on the screen by using a second lens in front of the first one. With the color screen still in place the red image would thus be obtained on the screen. The second combination lens would project the blue image which would be superposed on the first, and the same would be the case with the yellow image, so that the three differently-colored images being thus superposed upon the screen would give the image in natural colors. However, in practice, it would be a complicated matter to use three extra lenses. M. Chéron has found that he can concentrate all three images on the screen and at the same point by using a large condensing lens of the usual type, which he inserts in the circular socket surrounding the three lenses. It will be seen that the projection of the images on the screen is thus accomplished in a simple and quite automatic manner, since all the adjustments are made beforehand so that the three images fall upon the screen and are exactly matched, simply by placing the large lens in position. Thus the projection can be carried out by the use of the camera itself, and there is no extra apparatus whatever to be set up outside of the source of light and the screen.

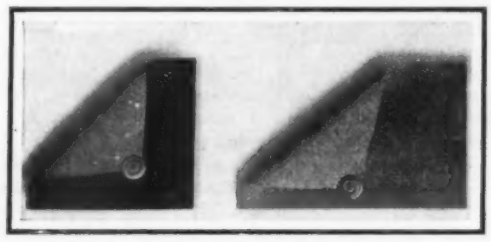


THE CAMERA WITH ITS THREE LENSES AND SOCKET IN FRONT FOR A COMMON CONDENSER.

Each of these lenses has a diaphragm which is set properly for the correct color values once for all for taking the photographs. However, the relation of the color values is not the same upon the photographic plate as it is for the eye, so that when it comes to the projection of the images the diaphragms have to be readjusted so as to give the correct proportions for human vision. This second adjustment, as well as the first one, is found once for all, so that it is repeated at will without any further trouble. In order to give the correct adjustment of the images, the plate holder which carries the transparency is mounted on a pivot, so that if there is any slight difference in position this can be corrected by observing the projection on the screen and turning the camera until the right effect is secured. Should it be desired to take views of objects being nearer the camera than the use of the constant-focus lenses will allow, we can insert the large condensing lens, or another lens of the same diameter can be placed in front of the three lenses. The rays from the object will be then rendered parallel by the large lens before they pass into the small ones.



SPECIMEN OF CORK-BACKED FABRIC.



FABRICS LINED WITH CORK.

An objection may be made that the pictures can only be viewed in colors instead of seeing them upon a single plate, as is the case with the Lumière process; but as the Lumière plates are not very transparent, they cannot be well projected except by calcium light or a strong arc light, and this is not always within reach of the amateur. M. Chéron's process allows of using a gas burner and can thus be employed by anyone, which is a distinct advantage when it comes to projection work. At the same time the views seen in large size on the screen are more agreeable than the small views. The size of the projected image, when an incandescent gas burner is used, is about three feet in diameter, and good illumination of the image is obtained. With a stronger light the diameter can of course be increased. Another point is that this new camera could, with certain modifications, be used for taking and projecting moving pictures in colors.

A reagent which yields a more delicate and characteristic test of the presence of arsenic than is given by Bettendorff's reagent is made by dissolving 1 part of calcium hyposulphite in 10 parts of fuming hydrochloric acid. A few drops of this solution added to the suspected liquid produce an orange red coloration on standing if arsenic is present. If the quantity of arsenic is large, a brown precipitate is ultimately formed.

TRANSPARENCY SHOWING THE THREE IMAGES FOR PROJECTION THROUGH THE THREE COLOR SCREENS.

THE MOST POWERFUL LOCOMOTIVES EVER BUILT.

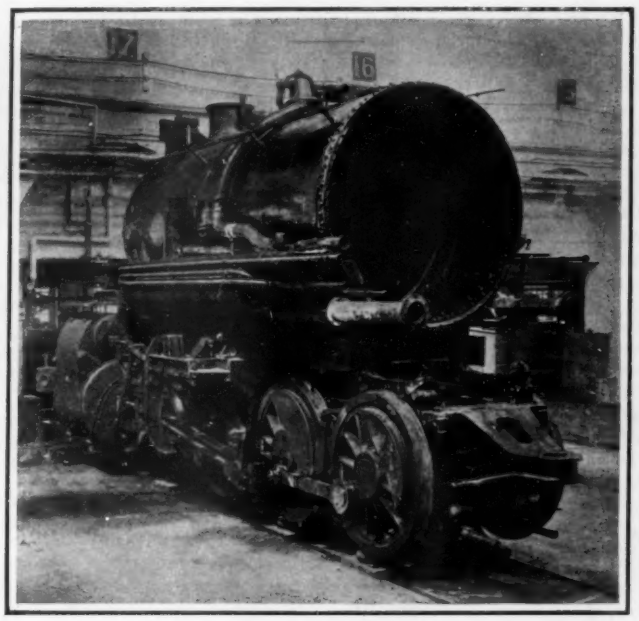
The Baldwin Locomotive Works have recently completed for the Southern Pacific Company two Mallet articulated compound locomotives, which are undoubtedly the heaviest engines thus far built for any railway. These locomotives have eight coupled wheels in each group, and in accordance with the previous practice of the builders, are equipped with two-wheeled leading and trailing trucks. The constructive details embody various features of special interest. The calculated tractive force of this design is 94,640 pounds. The locomotives will be used on the Sacramento Division between Roseville and Truckee, where the maximum grade is 116 feet per mile, and the rating 1,212 tons of cars and lading.

The enormous size of the engine will be readily appreciated from a study of the following dimensions: The high-pressure cylinders are 26 inches diameter by 30 inches stroke; and the low-pressure cylinders, 40 inches diameter by 30 inches stroke. The boiler is placed in the piping system between the high and low-pressure cylinders, is located in the smokebox.

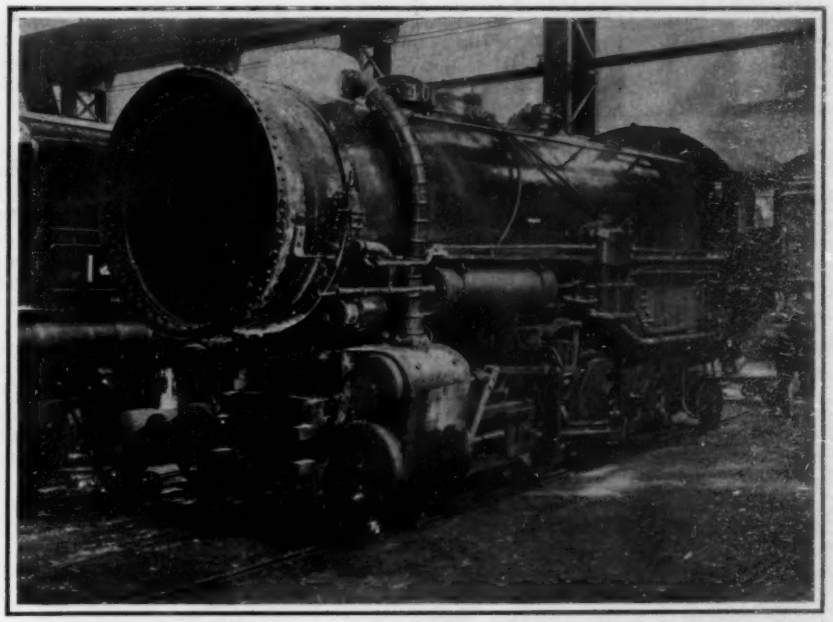
In order to facilitate repairs, the boiler is provided with a separable joint, which is placed at the rear end of the combustion chamber. The joint is effected by riveting a ring to each boiler section, and uniting the rings by 42 bolts, 1¼ inches in diameter. Two of the illustrations show the boiler separated at this point, the forward half resting upon the forward truck, upon which the low-pressure cylinders are carried, the rear half with the high-pressure cylinders being carried upon its own frame and wheels.

The waist-bearer under the combustion chamber is bolted into place, while the front waist-bearer and the high-pressure cylinder saddle are riveted to the shell. The dome, which is of cast steel, is placed immediately above the high-pressure cylinders, and the arrangement of the throttle and live steam pipes is similar to that used on heavy articulated locomotives previously built at these works. The exhaust from the high-pressure reverse shaft is placed on the center line of the engine, and is fitted with a universal joint located immediately above the articulated frame connection. The joint is guided between the inner walls of the high-pressure cylinder saddle. In this way the reversing connections are simplified, and when the engine is on a curve the angular position of the reach rod has practically no effect on the forward valve motion. This arrangement has been made the subject of a patent.

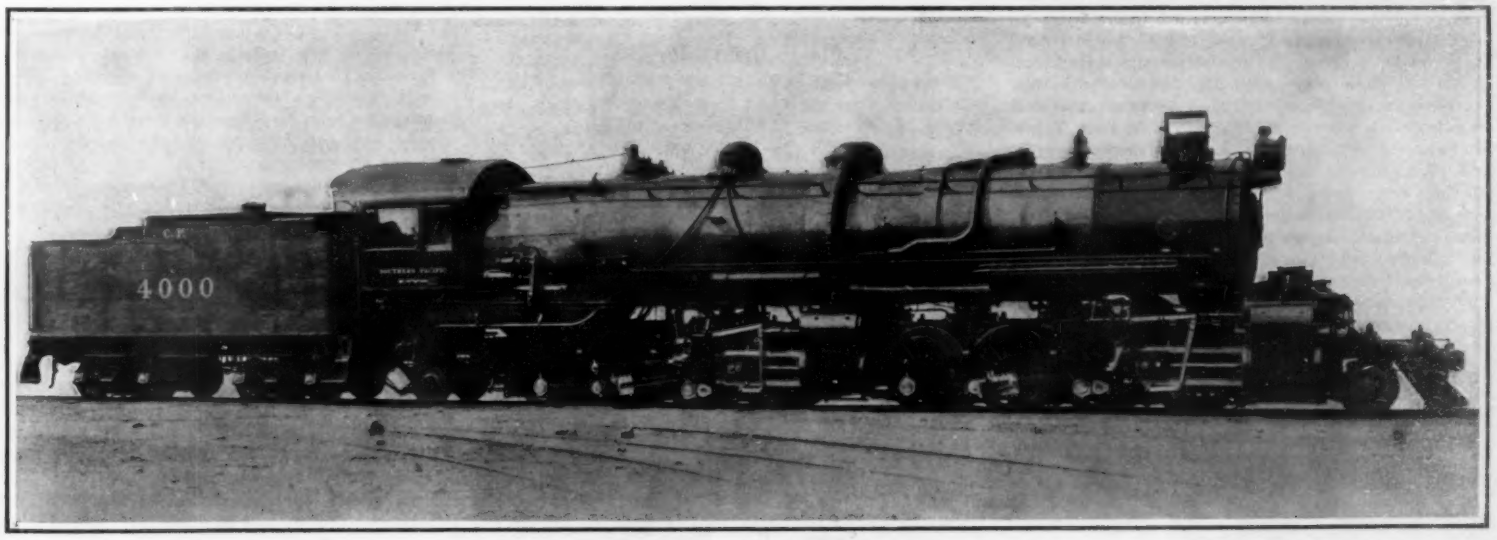
One of the locomotives is equipped with vanadium-steel frames, and the other with frames of carbon steel. The connection between the frames is single, and is effected by a cast-steel radius bar, which also constitutes a most substantial tie for the rear end of the front frames. The fulcrum pin is 7 inches in diameter; it is inserted from below, and held in place by a plate supported on a cast-steel crosstie, which spans the bottom rails of the rear frames between the high-pressure cylinders. The weights on the two



Low-pressure engine and truck with combustion chamber, superheater, and smokebox of boiler.



The boiler, separated at forward tube plate from combustion chamber. Mounted on the same frames are the high-pressure cylinders.



Total weight engine and tender, 300 tons. **Drawbar pull,** 94,640 pounds. **Cylinders:** Two high-pressure, 26 inches by 30 inches; two low-pressure, 40 inches by 30 inches. **Diameter of boiler,** 7 feet; heating surface, 6,393 square feet.

THE MOST POWERFUL LOCOMOTIVES EVER BUILT.

84 inches diameter; the firebox is 10 feet 6 inches long; the fire tubes, 21 feet long; and the feed-water heater tubes, 5 feet 3 inches long. The total heating surface is 6,393 square feet. The steam pressure is 200 pounds to the square inch. The total weight on drivers is 394,150 pounds; the total weight of engine is 425,900 pounds; and the engine and tender together weigh just under 300 tons. The maximum pull on the drawbar is 47 tons.

The boiler is straight-topped, 84 inches in diameter, and is equipped for oil burning. The fire tubes are 21 feet long; they terminate in a combustion chamber, 54 inches long, in front of which is a feed-water heater 63 inches in length. Two non-lifting injectors are provided, and they discharge, right and left, into the feed-water heater chamber, which is kept constantly filled with water. The feed passes out through the top of the chamber, and is then delivered into the main barrel through two checks, placed right and left immediately back of the front tube sheet. A superheater, sure cylinders passes into two pipes which lead to the superheater. The steam enters the superheater at the front end of the device and passes successively through six groups of tubes. It then enters a T connection, from which it is conveyed to the low-pressure cylinders through a single pipe having a ball joint at each end and a slip joint in the middle. The steam distribution is controlled by 15-inch piston valves, which are duplicates of those used on the high-pressure cylinders. The final exhaust passes out through the front of each casting, into a T connection, which communicates with a flexible pipe leading to the smokebox. The slip joint in this pipe is made tight by means of snap rings and leakage grooves. At the smokebox end the ball joint is fitted with a coiled spring, which holds the pipe against its seat.

Reversing is effected by the Raggonet power gear, which is operated by compressed air and is self-locking. The gear is directly connected to the high-pressure reverse shaft. The reach rod connection to the groups of wheels are equalized by contact between the front and rear frames, no equalizing bolts being used in this design. The front frames are stopped immediately ahead of the leading driving pedestals, where they are securely bolted to a large steel box casting, previously mentioned, which supports the low-pressure cylinders.

The boiler is supported on the front frames by two bearings, both of which have their sliding surfaces normally in contact. The front bearing carries the centering springs, and the wear is taken, in each case, by a cast-iron shoe 2 inches thick. Both bearings are fitted with clamps to keep the frames from falling away when the boiler is lifted.

The locomotive is readily separable, as the joint in the boiler is but a short distance ahead of the articulated frame connection, and all pipes which pass the joint are provided with unions. The separable feature was tested by the builders, and proved entirely feasible. The tender is designed in accordance with Asso-

ciated Lines standards, and is fitted with a 9,000-gallon water-bottom tank. The capacity for oil is 2,850 gallons. The trucks under both the locomotive and tender are equipped with "Standard" solid forged and rolled steel wheels. The detail parts of this locomotive have, where possible, been designed in accordance with existing standards of the Associated Lines. The engine is practically equivalent, in weight and capacity, to two large Consolidated type locomotives, and in spite of its great size, presents a pleasing and symmetrical appearance.

$200 in Prizes for the Best Garden.

If you have a small garden and you are proud of it, the readers of American Homes and Gardens want to know all about it. For the encouragement of those who have converted an unsightly lot into a lovely, blossoming piece of ground, however small, the Editor of American Homes and Gardens offers cash prizes aggregating $200.

The prizes are offered for the best-planted, developed and successful village or suburban gardens. The Editor and the readers of American Homes and Gardens want to know how you planted your garden and what success you had with it. You need not be a skilled writer to compete.

The unusual opportunity offered in the Garden Competition should call forth immediate and practical results. It is a project that should appeal alike to the owners and creators of gardens, and to those who want helpful hints and suggestions on the making of a small garden. For it is the home garden, the inexpensive home-grown garden, for which these prizes are offered. In other words, the gardens of the people, as distinguished from the gardens of the gardeners. Everyone may have a small garden, even if it be but a front yard, and it is precisely these home gardens which are made and tended by the family that are sought in this competition.

The Garden Competition raises the plain question, Who has the best garden? And the readers of the Scientific American are invited, with the utmost cordiality, to answer this question.

If your garden is a small one, so much the better. No garden is too unimportant for consideration in this competition, for the award of the prizes will be based on the merits of the gardens as gardens, and not on their size and cost.

This competition affords a splendid opportunity to give many persons pleasure by making known the beauties of your own garden to them; but it should help and stimulate others in new and other garden work, by giving them some detailed information as to the successful gardens others have created. And if one garden is good, two are better and three more so, until a whole community may be alive with this richest of rural treasures. The practical questions are, How is it done, and what can be done? These two questions, it is hoped, will be abundantly answered in the material sent in for this competition. We invite our subscribers and readers, and their friends, and the friends of their friends, who have gardens that they think of real interest and beauty, or who may possess choice bits of garden loveliness, to enter this competition.

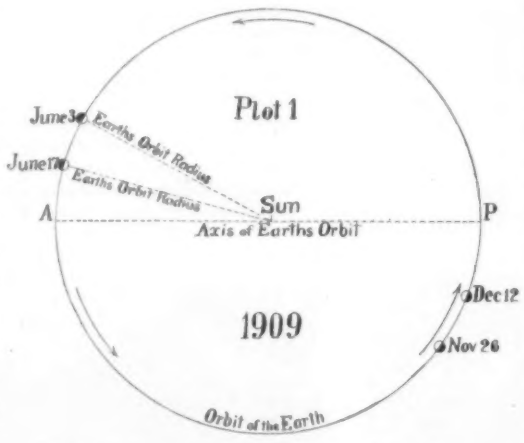
The full conditions of the contest will be found in the May number of American Homes and Gardens.

THE LUNAR AND SOLAR ECLIPSES IN JUNE, 1909.

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE.

The gradual advance of the dates of eclipses was clearly illustrated in the year 1908, which included three eclipse seasons; the first occurring in the month of January and the last in December, the average interval between eclipse seasons being less than six months. The plane of the moon's orbit makes one complete rotation in a direction contrary to her orbital motion in a little over eighteen years and a half. Ordinarily, the line of nodes comes into line with the radius of the earth's orbit twice each year, and an eclipse is possible only when the moon is at or near one of the nodes. In nine years the plane of the moon's orbit makes one-half a rotation; and as a consequence, one more eclipse season is included in the number which belongs to this period.

In the year 1909 there will be two eclipses of the sun and two of the moon—on June 3rd, a total eclipse of the moon; on June 17th, a central eclipse of the sun; on November 26th, a total eclipse of the moon; and on December 12th, a partial eclipse of the sun. The position of the earth at the time of the eclipse is shown for each of these dates in Plot 1.



Position of the earth at the time of the eclipse.

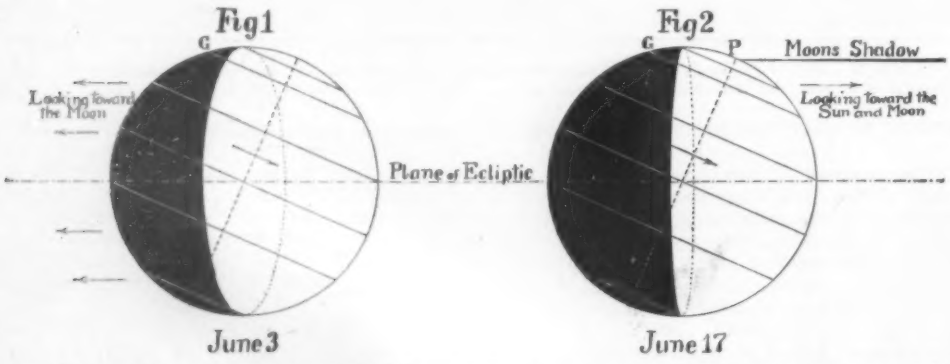
Plot 2 is a plot of the moon's orbit for the month of June. That part of the orbit which is above the plane of the ecliptic is represented by a full line. The position of the moon is shown at Greenwich noon for each day from the 1st to the 28th; and also for the 3rd and 17th at the time of the eclipse. In each case the projection of the moon's orbit radius on the plane of the ecliptic would coincide with that of the earth if the two plots were combined in one drawing. Since they are shown separately, they are respectively parallel; and the line of nodes $N\,N'$ is shown in its position relatively to the orbit radii of the earth and moon.

The moon's orbit for the month of June.

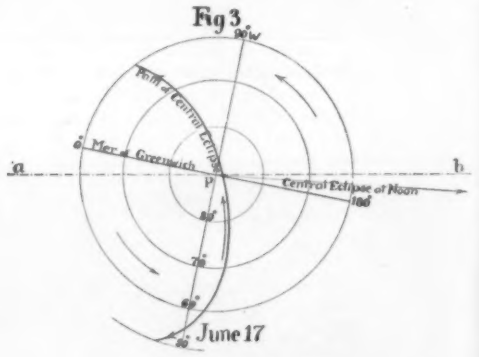
Figs. 1 and 2 are projections of the earth on a plane which is parallel to its axis and perpendicular to the plane of the ecliptic at the dates of the eclipses. In these projections more than one-half of the visible hemisphere is illuminated between the dates of the vernal equinox and the summer solstice. This area gradually diminishes as illustrated in the figures, which may be compared with the positions of the earth shown at the corresponding dates in Plot 1.

On June 3rd, 13.5 h., when the moon will be near the descending node N', she will come wholly within the earth's shadow. The eclipse, seen in the direction of the arrows, will be partly visible at Washington, the moon rising eclipsed. The beginning of the eclipse will be visible in South America, Africa, Europe, and southwestern Asia. The end will be visible in Africa, central and western Europe, South America, and nearly the whole of North America.

During the interval between the two eclipses the moon's orbit will be below the plane of the ecliptic, as shown by the dotted line. The eclipse of the sun on the 17th (17 d. 11.5 h.) will occur some time after the moon has passed the ascending node N. The distance from the ecliptic will be so great that the vertex of the moon's shadow will pass very near the north pole. (Fig. 2.) The path of the moon's shadow is shown in Fig. 3, which is an enlarged projection of a portion of the earth's surface near the pole on a plane which is perpendicular to its axis. In this projection the position of the meridian of Greenwich, and of one from which a central eclipse will be visible at noon, are shown. The latter, in Fig. 2, is indistinguishable from the great circle which represents the earth, which is approaching the summer solstice, when the meridian at noon will coincide with $a\ b$, the plane perpendicular to the ecliptic which will contain the earth's axis. The central eclipse between latitudes 51.5 deg. N. and 64.25 deg. N. will be total; and beyond these limits it will be annular. In Fig. 3 the path of totality is limited by arrowheads. A central eclipse shows that the vertex of the moon's shadow reaches the earth where the eclipse is total; and that it does not quite reach it beyond these limits; i. e., the length of the shadow does not differ very much from that of the moon's orbit radius, which at the date of the solar eclipse will be about 236,000 miles. As a partial eclipse it will be visible in nearly all North America, Greenland, Iceland, Japan, north Philippines, China, Siberia, and a small part of northern Europe. It will be visible at Washington, the sun setting eclipsed.



Projections of the earth on a plane which is parallel to its axis and perpendicular to the plane of the ecliptic at the dates of the eclipses.



The path of totality.

A $10,000 Aviation Prize for America.

With a view to encouraging inventors to complete their machines and make flights this summer at New York, the Aeronautic Society has decided to offer a prize of $10,000 for a flight of 100 miles. This prize will be divided into five sections, the first of which—$2,000—will be awarded to the aviator who makes the fastest circuit of the Morris Park race track—1¾ miles—at the first 1909 exhibition and meet of the Society on the 29th instant; or, if no machine makes the flight on that date, to the first one that accomplishes it upon any subsequent exhibition-flight day, which will probably be Saturdays throughout the summer. Proportionate amounts will be given for a flight less than a complete circuit on May 29th. As soon as the first section has been won, announcement will be made of the flight required to win the second section, etc.

The offering of so liberal a prize *for flying machines only* at this time should make it worth the while of wealthy sportsmen to aid inventors to a considerable extent financially, with the object in view of winning it. Besides flying for the cash prize, each aviator can at the same time set up a record for the Scientific American Trophy—a record which, if unsurpassed during the year, will entitle the holder to be declared the winner for 1909 and to have his name and record inscribed upon the trophy. Any aviator winning it three times in three different years will become the permanent winner.

To encourage its members, over a score of whom are building aeroplanes, the Aeronautic Society has offered three $250 prizes for the first three machines making a flight of 500 feet at Morris Park.

Correspondence.

TRUTH ABOUT THE "DREADNOUGHTS."

To the Editor of the SCIENTIFIC AMERICAN:

As a constant reader of the SCIENTIFIC AMERICAN I read with great pleasure your article in the last issue, "The Truth About the German 'Dreadnoughts.'" I wish to say that I have always followed the naval constructions of the different powers very closely, and find that your statement is absolutely correct as to the numbers of ships laid down by Germany, their armaments, etc.

After having read so many articles about the "menace" of the German navy, the exaggerated numbers of ships laid down by Germany, as seen almost daily in the British newspapers, and, sorry to say, copied quite extensively by many papers in this country, it is really refreshing to read the plain truth which you have so nobly represented to your readers, and which, believe me, will not only make the SCIENTIFIC AMERICAN the cleanest and most reliable paper in this country, but will make it a necessity to every reader who reads to learn the truth!

Cincinnati, O. LOUIS KAYSER.

THE NEW GERMAN PHOTOGRAPHY.

To the Editor of the SCIENTIFIC AMERICAN:

I noticed in your last week's issue an article regarding a new phonograph invented by Nees, Hamburg, Germany. As your article gave but little data on its workings, perhaps the following may prove of interest to your readers.

The instrument is a clumsy affair, its waxed recording and transmitting cylinder being about ten times larger than the ordinary phonograph. The recording, however, is made very much like the common type of instrument: the vibrations of the stylus are tangential to the cylinder.

In the transmitter no stylus is used, nor vibrating diaphragm, but a smooth cylinder revolving synchronously with the waxed one, and in contact with it. A fine jet of compressed air is directed against the line of vibrations on the wax and can only escape through the grooves in the wax made by the stylus in the recorder. In line with the jet of air is placed the horn, thus involving the characteristics of a syren.

Washington, D. C. E. H. HAWLEY.

More About Signaling to Mars.

Prof. Pickering's idea of signaling to Mars by means of a huge system of mirrors, which will flash the sun's light rhythmically to our planetary neighbor, seems to have attracted not a little attention, and to have called forth other schemes from more or less eminent scientists.

Prof. Pickering believes that $100,000 should be spent in preliminary work before any attempt is made to flash signals. These preparations will consist in the building of a huge telescope, and in experimental observations made with the co-operation of the foremost astronomers of the world. The object of this preliminary work is to decide whether or not the canals of Mars are really artificial. In all, three years' time would be consumed in these preliminaries.

A correspondent of the New York Sun, who states that he is a practical heliograph man, calls attention to a fact which seems to have been overlooked. Prof. Pickering proposes to make mirrors of such a size that they must necessarily be moved by machinery. His idea appears to be that if they were each ten feet across, there would be about 500 of them to the mile. The heliograph man points out that a pocket mirror two inches square will do just as much work as a mirror that is ten feet square. All that any mirror can reflect is the single image of the sun. He states that it is possible to flash from 6 to 48 miles with a shaving glass. This seems to be borne out by the fact that the standard size of an army heliograph is less than 4 inches. Hence, 10-foot mirrors would hardly be any more serviceable than 4-inch mirrors. The Sun's correspondent suggests that instead of spending $10,000,000 on an elaborate system of mechanically-moved mirrors, it will be much cheaper to buy 5,000 10-cent mirrors, or to make a bargain with any looking-glass manufacturer to sell scraps of silvered plate glass at least two inches square. An army of 5,000 men should then be deployed, stationed ten feet apart on the Staked Plains of Texas. They should be given a front sight which will enable them to aim at Mars.

Prof. David Todd of Amherst College also intends to improve the opportunity offered by the earth's proximity to Mars next autumn to discover whether or not the planet is really inhabited. He assumes that if Mars has inhabitants, and if they are as intelligent as we are, they may possibly attempt to communicate with the earth at that time, and that they may employ Hertzian waves for the purpose. It is his plan to take the most sensitive wireless telegraph receivers he can find up in a balloon, in order to diminish any obstructive influence that the atmosphere may exert, and listen for signals in space. We wonder how Prof. Todd can tell whether his signals come from Mars, or whether the receivers have not simply responded to electrical waves sent out from the sun.

Attention has already been called in these columns to Prof. Wood's idea of using a large black spot on the white alkali plains, with which signals may be "winked." According to Prof. Wood, the spot could be made in small sections of black cloth arranged to roll up on cylinders, exposing the white ground underneath, the cylinders being turned simultaneously by electric motors.

Official Meteorological Summary, New York, N. Y., April, 1909.

Atmospheric pressure: Highest, 30.65; lowest, 29.70; mean, 30.06. Temperature: Highest, 80; date, 19th; lowest, 24; date, 11th; mean of warmest day, 64.5; date, 19th; coolest day, 34.5; date, 11th; mean of maximum for the month, 57; mean of minimum, 42; absolute mean, 49.5; normal, 48.7; excess compared with mean of 39 years, 0.8. Warmest mean temperacure of April, 54, in 1871; coldest mean, 41, in 1874. Absolute maximum and minimum for this month for 39 years, 90 and 20. Average daily excess since January 1, 2.6. Precipitation: 5.93; greatest in 24 hours, 2.80; date, 14th and 15th; average of this month for 39 years, 3.39. Excess, 2.54. Accumulated excess since January 1, 1.80. Greatest April precipitation, 7.02, in 1874; least, 1.00, in 1881. Snowfall, melting as it fell, 0.08 inch. Wind: Prevailing direction, northwest; total movement, 10,420 miles; average velocity, 14.5 miles per hour; maximum velocity, 83 miles per hour. Weather: Clear days, 8; partly cloudy, 8; cloudy, 14. In which 0.01 inch or more of precipitation occurred, 15. Fog (dense), 19th; sleet, 29th; frost, light, 16th, 25th; heavy, 12th; killing, 11th. Thunderstorms, 19th, 21st, 22nd, 29th.

The Current Supplement.

There has recently been acquired by the Bavarian state railroad for the haulage of motor coaches over short distances, a new type of steam motor which embodies several novel features. This new motor coach is described and illustrated in the opening article of the current SUPPLEMENT, No. 1741. Mr. Prevost Hubbard, of the United States Department of Agriculture, contributes an authoritative discussion of the temporary tar and oil binders, emulsions, and similar preparations as dust preventives. An ingenious apparatus for destroying moths is described, which apparatus consists of nothing more or less than a powerful searchlight which attracts the moths, and a trap for impounding them. The use of the gyroscope for the steadying of aeroplanes is set forth by Lucien Fournier. The cost of electric heat is estimated in the light of the most recent information. Sir Oliver Lodge sets forth briefly the modern electrical view of matter. Among the minor articles may be mentioned those on the new British battleship "Vanguard," "Aerial Flight in Theory and Practice," "Synthetic Preparation of Ammonia," "A Home-made Pneumatic Elevator," and "A Revolutionary Proposal in Blast Furnace Construction." Prof. Molisch describes a method of detecting the heat which emanates from living foliage. Mr. Lanchester's interesting paper on the Flight of Birds is concluded. S. H. Higgins writes on the Theory of Dyeing. The recent newspaper discussion of the habitability of Mars renders timely Mr. F. W. Henkel's popular article on Life in Other Worlds. The usual Engineering Notes, Science Notes, and Trade Notes will be found in their accustomed places.

THE PALACE OF MIRAGES.

BY JACQUES BOYER.

The apparent multiplication of objects placed between two parallel mirrors is a well-known optical phenomenon. The spectator's image is reflected from one polished surface to the other and back again. Inasmuch as at each reflection another image is added to the preceding image and the perspective is increased, the spectator sees himself infinitely multiplied, at least theoretically.

During the International Exposition of 1900 at Paris, Eugène Hénard built a Palace of Illusions on the Champ de Mars, in which structure reflecting mirrors were made to produce endless duplicates of architectural effects, electrical illumination being employed to increase the mystifying illusion. Somewhat similar, but even more bewildering, is the Musée Grevin which has recently been erected in Paris.

Hénard's "Palace of Illusions" comprised a hexagonal room about twenty meters (65.6 feet) in diameter, the walls of which were mirrors, framed in great Moorish arches resting on columns and pedestals located at the six angles of the hexagon. A dome carried on arches surmounted the whole. The optical repetition of the same architectural *motifs* created in the spectator the illusion of a great number of halls extending endlessly in all directions. In Fig. 1, the manner in which this effect was produced is clearly shown. The hall itself is shown in the center of the drawing by cross hatch lines, together with the six mirrors and the six columns. Immediately surrounding this hall, the spectator saw six exactly similar halls (shown in vertical lines), the result of the first reflection. Beyond this first reflection the spectator saw a second series of halls (horizontal lines), and farther on a third, which in turn was surrounded by other hexagons, and so on in an infinite series.

Considering only the first three repetitions, it will be observed that six halls are produced by the first reflection, twelve by the second and eighteen by the third. A man standing in the center will, therefore, easily distinguish thirty-six halls comparatively close to him, and for the following reflections a still larger number of halls, which increases indefinitely. It is evident that a particular piece of decoration, illuminated either with visible electric lamps or by spot lights, will be instantly multiplied in all directions, producing a wonderful spectacle.

The "Palace of Illusions" of 1900 was so illuminated that fifteen different luminous effects could be obtained, so beautiful that 2,000,000 visitors paid to wonder at the illusion.

The "Palace of Mirages" is a development of the idea which was carried out in the "Palace of Illusions." Whereas the "Palace of Illusions" could boast of only a single scheme of decoration, there are no less than three such schemes in the "Palace of Mirages"; that is, independently of lighting effects, the spectator is presented with three absolutely distinct effects.

This improvement has been effected by Hénard by employing, in addition to six large fixed mirrors for the walls, twelve smaller revoluble mirrors, which constitute the angles of the hexagon, and to which architectural *motifs* are applied. These smaller mirrors are pivotally mounted, so that they can be turned to present three different varieties of decorations for reflection. In Fig. 2 the principle of the mechanism is disclosed. At each of the angles of the hall six rotary drums are mounted, carrying six mirrors arranged in pairs, and forming three angles of 120 degrees each. Each angle of the hexagon also measures 120 degrees. Hence, by giving the drum one-third of a turn, the entire aspect of the hall and its perspective is changed. By means of a very delicate, electrically-controlled mechanism, the six drums can be turned either independently or simultaneously. When stationary, the mirrors of the drums complete the angle of the hexagon, so that they are apparently part of the walls. The drums are actuated by a friction wheel, and are stopped without shock by means of a brake of special construction. This precaution is absolutely necessary, when it is considered that even a very slight jar might shake off the very elaborate decorations applied to the mirrors.

In order to obtain sharp contrasts in effects, M. Hénard has interpolated a forest scene between two architectural illusions. By placing at the six angles of the hexagon tree trunks of different forms, the vast number of reflections produced by the mirrors leads the spectator to believe that he is the center of forest avenues radiating from him. It became necessary in carrying out this scheme to conceal the dome by a covering of foliage. This is accomplished by means of a flexible painted fabric, which slides through a central ring and which is capable of expanding to form a ceiling of leaves for the hall. The fabric is dropped by means of wires and invisible counterweights.

The three schemes of decoration selected are the following: A Hindu temple, a forest, an Arabian palace.

Although these three schemes of decoration themselves render it possible to obtain wonderful effects, Hénard has seen fit to heighten their possibilities by electric illumination. In the Palace of Illusions of 1900, fifteen different luminous effects could be obtained, but in the Palace of Mirages about three times as many are possible. In other words, 45 different luminous effects are obtained by means of 2,500 colored electric lamps, of which 1,800 can be simultaneously illuminated for the final effect in the last scene. If it be considered that the first three reflections produce an illusion of 36 halls, then the resulting illumination is equivalent to 36 x 1,800, or 64,800 lamps.

This system of electrical illumination is supplied with direct current of 500 amperes and 110 volts. In order to bewilder the spectator as much as possible, Hénard employs moving as well as fixed incandescent lamps. The moving lamps are tellingly employed in the forest reflections. Amid the foliage shimmering in the pale light of the moon, swarms of luminous butterflies are seen beating their wings incessantly. Presently, the butterflies disappear, and a shower of multi-colored stars drop from the branches.

The forty-five different luminous effects are obtained by means of a special switchboard which is nothing more nor less than a keyboard having forty-five keys. Whenever a key is depressed, a new luminous effect is obtained. In other words, the electrician plays on a kind of switchboard piano, and changes the illumination at will.

The manufacture of the mirrors was no light task. It was necessary that they should be absolutely plane surfaces, so that no distortions in reflections would be produced.

Had this precaution not been observed, the alignment of the galleries would have been destroyed, and with it the optical illusion. Furthermore, the sides of the angles formed by the movable mirrors had to coincide exactly with the plane of the fixed mirrors.

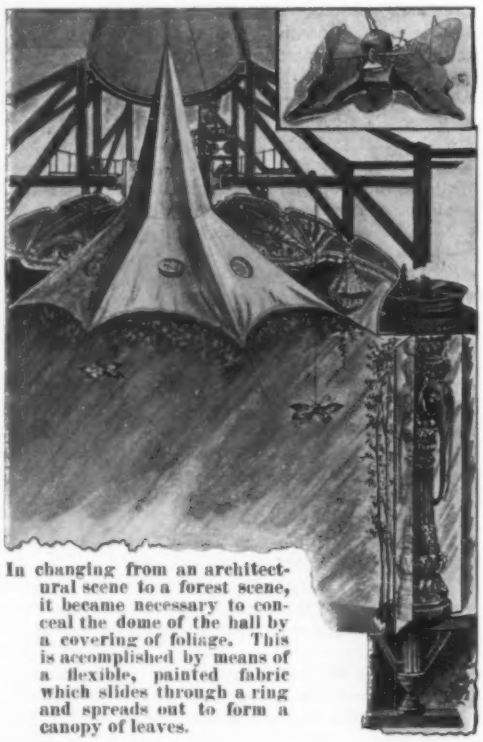
Since there are 36 revolving mirrors, it is evident that the difficulty to be surmounted was not insignificant. Furthermore, when it is considered that the six large fixed mirrors constituting the sides of the hexagon are enormous, measuring no less than 11 feet by 16 feet, we are safe in saying that they are the largest of their kind which have thus far been manufactured.

Let us now enter the "Palace of Mirages" and obtain some idea, if we can, of the wonderful sights there to be seen.

We pass into a hall of apparently immense size, surrounded by mysterious galleries, which lose themselves in infinite depths. The roofs of these galleries are supported by massive columns in the Hindu style of architecture. The columns are surmounted by elephants' heads richly carved and studded with gems. Around the heads of the elephants great serpents are coiled. At one of the angles of the hall looms the Hindu Trinity: Vishnu, the conserving god; Brahma, the creating god; and Siva, the destroying god. The silence of the hall is broken by a few musical chords. Suddenly the eyes of the elephants open. The stones which serve as their eyes and decorations glow in varied colored lights, and the great serpents shimmer like emeralds. Vari-colored lights flash from the ceiling, and pass through all the shades of the spectrum. An immense lotus flower bursts into light in the center of the dome.

The music becomes wilder, and the colors merge into purple and delicate red. The serpents assume a scarlet tinge. The scene is like a brief glimpse of Inferno.

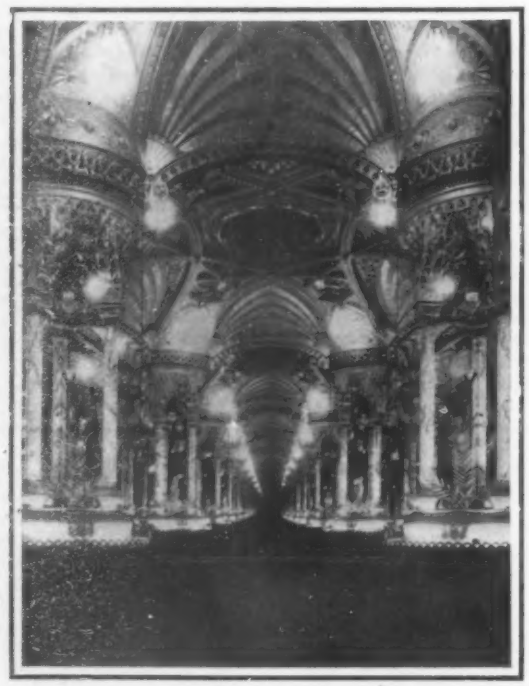
A bell sounds. The entire hall is plunged into darkness. In the gloom columns can vaguely be seen as they shift. Forms appear and disappear. Suddenly the light flares out again, and the spectator finds himself transported into a forest. As far as the eye can see are avenues of oaks, birches, elms, and hawthorns in full bloom. A canopy of leaves spreads out above the trunks of the trees. Bushes grow around the trees. A soft light filters through the branches. The leaves are touched with the gold of autumn. It is a veritable enchanted forest. Soft music accompanies this delightful vision. Presently a blue butterfly drops from above, beating its wings. He is followed by a superb peacock, and then by a flying cloud of luminous exotic moths. A bluish light suffuses the scene. Stars begin to appear. One, two, then ten, finally a million, apparently drop down from the branches, only to be extinguished as they reach the ground. It is like a shower of light, a rain of meteors. When the last star has fallen and has been extinguished, night descends, and complete obscurity reigns once more.



In changing from an architectural scene to a forest scene, it became necessary to conceal the dome of the hall by a covering of foliage. This is accomplished by means of a flexible, painted fabric which slides through a ring and spreads out to form a canopy of leaves.

Another peal of the bell is heard. The light gradually increases. In the faint illumination the spectator sees long avenues flanked by columns of luminous onyx. He wonders if he is at the court of a Khalif or in the Palace of Aladdin. The dome shines like a sun. The music of a triumphant march rings through the halls. Everything grows brighter and brighter, increasing in brilliancy. Every column scintillates, every arch, every capital, every curve, seems outlined in sapphires, diamonds, and rubies. Columns seem crowned by diadems of precious stones. Mad arabesques seem reproduced infinitely. Everywhere stars shine as though in an endless firmament. Finally, the entire dome blazes forth a brilliant glare of light.

A conference was held at Brussels for repressing the use of saccharine in food products or drink. While the drug has 400 times the sweetening power of sugar, it is dangerous to health and it is desired to prevent the fraudulent use of the product. Delegates were present from all parts of Europe, and it was decided to hold a new conference on the subject at Geneva during the next spring. A resolution regulating the use of saccharine was adopted. Fiscal agents will look after the manufacture and destination of the product and see where it is employed. In many countries of Europe it is brought in by contraband, and in one case there was found in a vessel in the Russian port of Riga about a ton of saccharine, which would replace 400 tons of sugar.



The Arabian palace. By playing upon the keyboard shown opposite, wonderful luminous effects are obtained.

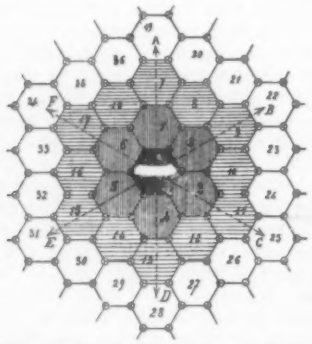


Fig. 1.—How images were multiplied by reflection in "Palace of Illusions."

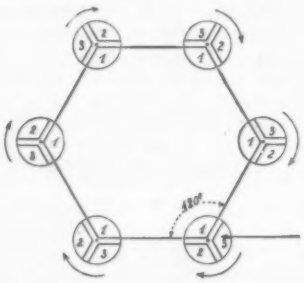
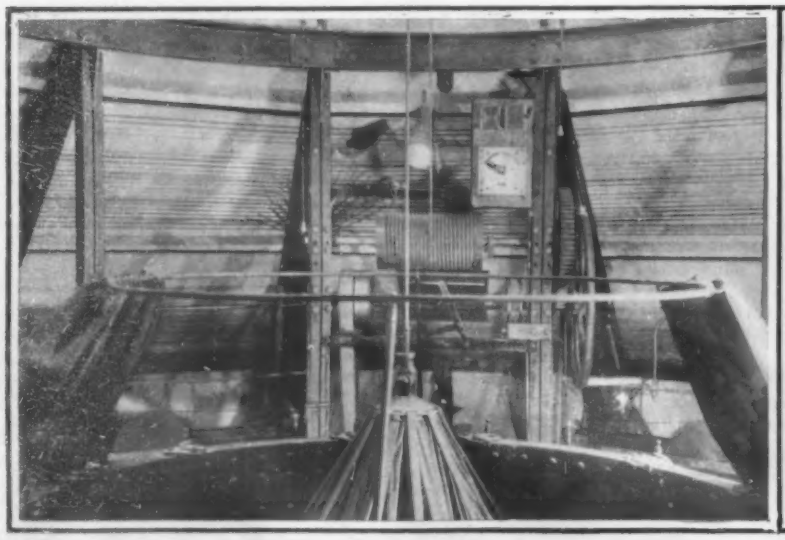
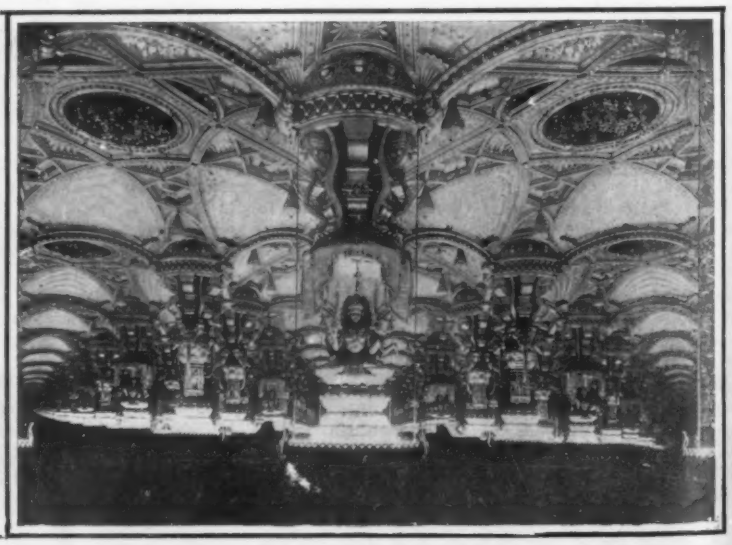


Fig. 2.—Arrangement of revoluble mirrors in "Palace of Mirages."

The keyboard by means of which the illumination is changed.



The mechanism by which the painted fabric is dropped which serves as the leafy roof of the central hall in the forest scene.



The Hindu temple, one of the three optical illusions produced in the "Palace of Mirages" by the aid of mirrors.

THE "PALACE OF MIRAGES."

THE EXCAVATIONS AT DELPHI

SOME STRIKING DISCOVERIES MADE BY M. HOMOLLE

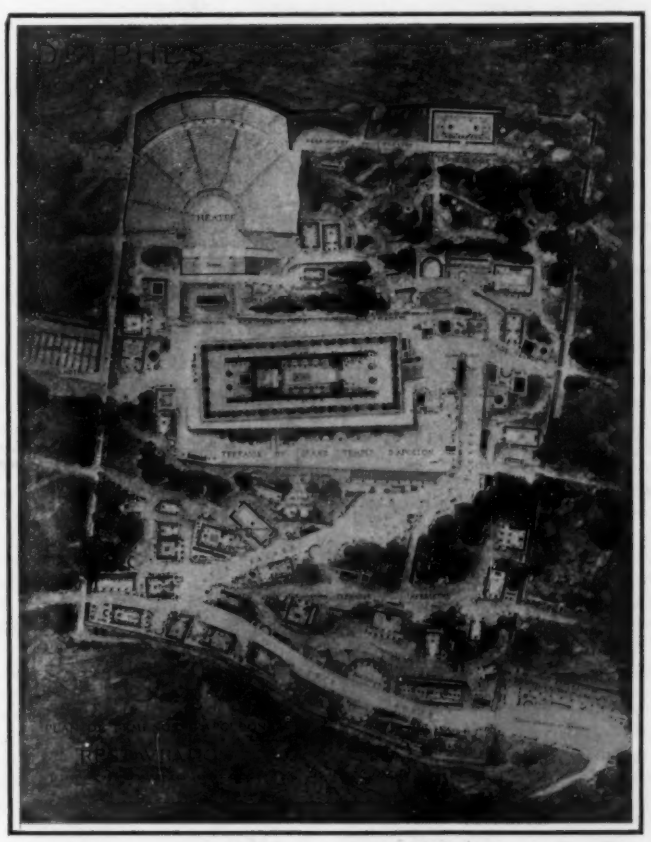
BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN

The whole of the site of the sacred inclosure of Delphi has now been uncovered by the excavations which have been carried on by the French School of Athens, under the direction of the eminent archæologist M. Homolle. We have already referred to this subject, but the undertaking is so large in scope that it affords an almost inexhaustible field for description. The rights of excavation on the site of Delphi were conceded to the French government by a diplomatic agreement which was ratified by the French and Hellenic parliaments in 1891. It was far from easy to carry on the work of excavation. The site of the ancient sacred inclosure was covered by the village of Castri. Measures had to be taken for removing the whole village, and this required no less than two years, as it was a community of about a thousand inhabitants and contained four hundred houses. This operation alone entailed an expense of over $50,000 before any of the excavation work could be commenced.

As to the scope of the excavations which the French School of Athens carried out, this work bears upon the entire sacred inclosure containing the temple of Apollo and the theater, as well as all the portions which depended upon it, including the stadium, the gymnasium, the celebrated spring of Cassotis, and various edifices. The work of uncovering this extensive area required as many as 400 workmen and several miles of track for the 75 light cars which were used for removing the earth. The extent of the excavations covers about a mile and a half in length. In all this large area the excavation was carried down to the virgin soil.

A wonderful assemblage of artistic riches adorned Delphi. There are votive buildings, statues, and various commemorative offerings. Delphi was the great religious center of Greece, and kings and representatives of various nations came to consult the oracle. On such occasions, as well as after great victories or where there were special reasons for thanksgiving, there were erected what are known as the treasuries or small temple structures containing, no doubt, various precious objects offered to Apollo. These structures had a high artistic value. Bronze and marble groups were in abundance all around the sacred inclosure, and these were executed, no doubt, by the most celebrated artists. We have one marble statue which is a copy of a work of Lysippus, and a figure taken from a bronze chariot group, one of the most remark-

A charioteer, constituting part of a group comprising a chariot and four horses.



Plan of the Temple of Apollo restored by Homolle.

Figure on the capital of the acanthus column.

The Treasure of Cnidos.

RECENT EXCAVATIONS AT DELPHI.

able to be excavated within recent years. What remains have been found—and some of them are illustrated here—fully justify the restoration of the sacred inclosure and its monuments under the direction of M. Homolle.

In the accompanying plan view we have a good idea of how the various structures in the Temenos were distributed. The whole, including the theater, is surrounded by a wall, making the inclosure of a somewhat rectangular form. It extends up a rather steep slope of the mountain side. In the central part is the great Temple of Apollo, which was erected upon a vast terrace or esplanade, thus commanding a view over all the surrounding country. Above, on a higher level, is the theater, while on the lowest land in the foreground are grouped the different votive structures. We also observe the Sacred Way, which winds up the slope and is bordered by the various buildings, finally reaching the temple terrace. Outside the walls there is a large paved area where the religious processions could be formed before proceeding within the inclosure and along the Sacred Way. On one side of this area was the Merchants' Portico where various objects were sold, no doubt of a religious character.

One of the most striking of the small votive buildings is the Treasury of Cnidos, which is in the Ionic style, and enough of the remains were found to justify a complete reconstruction such as is now to be seen in the Athens Museum. This is shown in one of the present views. This reconstruction was made from the portions of frieze which were found and also of the fronton, together with one of the caryatides and various architectural *motifs* which gave the pattern of the borders and other details. Measuring about twenty by thirty feet, it is formed of a small *cella* preceded by the entrance portico or *prodomos*. The two caryatides are draped female figures of the archaic style, and back of them is the entrance door which is surrounded by a richly decorated lintel. Parts of the frieze are well preserved. On the front side the frieze represents the combat of the Greeks and Trojans around the body of Euphorbus, under the eye of the divinities assembled in Olympus, who were following the struggle and encouraging the various heroes by their gestures. The assembly of divinities bears some analogy to the well-known scene which is represented on the frieze of the Parthenon. On the west side the frieze shows the apotheosis of Hercules, who is introduced into Olympus by Athena borne on a chariot with winged horses, and herself represented as winged, while at the other end Hebe descends from her chariot. The west frieze bears the carrying away of the daughters of Leukippos by Castor and Pollux, with three chariots and horses recalling the Pantheon frieze. A group full of movement is shown on the north frieze, which represents the Gigantomachy, or combat of gods and giants, a favorite subject of sculpture. On the fronton is a group representing the dispute for the sacred Tripod between Apollo and Hercules. The figures are here sculptured in high relief in the lower part and are entirely detached in the upper part. We also show a detail view of this group, and it is of interest as showing the appearance of the celebrated Tripod upon which sat the Pythia in the farthermost inclosure of the temple and on the border of the opening below which flowed the sacred spring of Castalia.

Regarding the oracle of Delphi, M. Homolle states that in the early period of the sacred spot and before the temple of Apollo had been built, the oracle occupied what was known as the sanctuary of the Earth and the Muses, and here were the Rocks of the Sibyl. The sacred spring also flowed underneath this spot. When the great temple was built, the seat of the Oracle was transferred to this place, and it remained there during all the history of Delphi. Daochos, the tetrarch of Thessaly, erected a votive offering at Delphi consisting of eight life-sized marble statues ranged in line upon a long base structure. The remains of all these statues have been found, and one of them, which is shown here, is very well preserved. These statues (fourth century B. C.) represented the various members of the family of Daochos, and the present one is the athlete Agias. It is to be reckoned among the most important artistic finds of recent years, as it appears to be the work of Lysippus or at least of his school. The present statues are in marble and are copies of a similar *ex-voto* group in bronze which existed at Pharsale, no doubt very faithfully executed after the originals. We should not forget that Delphi may be likened to a vast concourse of artistic works, so that only the very best were likely to be erected there. We recognize the qualities of the work of Lysippus in the length of the proportions, the small size of the head and the careful rendering of the hair. The expression of the face, with half-open mouth, is to be observed. Under each of the statues was engraved the inscription giving the name of the person. We thus have the remains of Sisyphos I, the father of Daochos, in a short tunic; Telamachos, his great-uncle, as a young man leaning upon a Hermes, also the cloaked figure of Sisyphos II, his son, which is larger than life. The heads of these statues are missing, however.

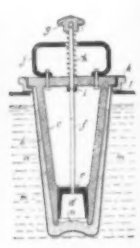
Lack of space forbids us to give more than a passing mention of some of the remarkable objects which are here illustrated, such as the bronze charioteer forming part of a group with chariot and four horses, also the colossal marble Sphinx of Naxos (sixth century B. C.) mounted on the top of a high column, and the three graceful female figures forming the top of the acanthus column.

GOBLETS OF ICE.

It would be well for inventors to study the advantages of reversing or inverting well-established customs or methods of procedure with a view to developing new and valuable inventions. For example, a native of Holland recently conceived the idea that instead of putting ice in a beverage it would be a good plan to pour the beverage into ice. This led to the invention of the ice goblet. For such a novel vessel there existed no precedent, and in the building of a machine for making it, many physical and technical difficulties had to be overcome. The apparatus has now been reduced to a commercial form and the inventor, Mr. H. D. P. Huizer, has installed a plant at one of the summer resorts near the Hague (Netherlands). The apparatus was also exhibited in Paris, last October, before the First International Refrigerating Congress.

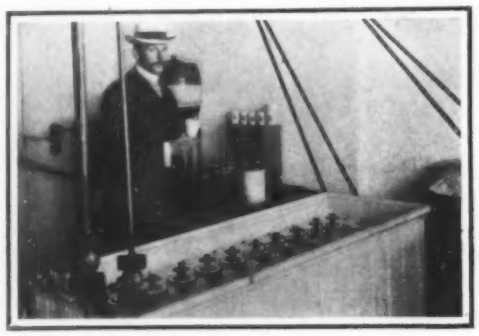
The ice goblet as shown in one of the engravings is a conical drinking vessel like a tumbler made entirely of ice which is placed in a smaller paper shell for convenience in handling and for protection against surrounding heat and direct contact with warm bodies such as the hand, table, etc. It weighs 3½ ounces and is 5 inches high. The walls, which are slightly tapered, are about ⅛ of an inch thick and terminate

The ice goblet complete.



Forming the ice goblet.

The ice goblet shown in section.



Selling beverages in goblets of ice.

GOBLETS OF ICE.

in an arched bottom of ⅜ inch thickness. It has a capacity of ¼ liter (about ½ pint). By a special process the ice may be made in all degrees of transparency or opacity, and even with a flowery structure. It can also be colored to give it a pleasing aspect. A drink out of one of these goblets is said to be delightfully refreshing and not as cold as one would think.

The refrigerating capacity is quite sufficient to hold the beverage about half an hour in summer; but it collapses instantly at a second refilling. As it thus can be used only once, the sanitary properties are ideal. Everyone has his own goblet, which is thrown away after use. In its manufacture it is not touched by the hand, and by using pure or distilled water an absolutely clean goblet is obtained. The paper shell is thrown away after being used a single time, because when wet it loses its shape and it does not pay to dry and reform it.

One would imagine that ice was entirely unsuitable for such a purpose, but as is well known a great deal of heat is absorbed in melting ice. In the goblet the ice is insulated by the paper incasing it and itself insulates the liquid within, while the difference of temperature between the two diminishes rapidly, thus arresting the melting of the inner side. Owing to these very favorable conditions the goblet has an astonishingly long existence. The same ice goblet thrown in water would melt away in a few minutes.

One of the illustrations shows in section the apparatus for making the goblet. It consists of a mold *a* and a core *c*. A measured quantity of water is first poured into the mold, then the core is inserted, which presses the water upward in the space *b* between the two. The device is submerged in refrigerating brine *m*. If the temperature of the brine is kept at —10 deg. C. (14 deg. F.) the ice goblet is ready in a quarter of an hour, at —20 deg. C. (—4 deg. F.) in but 6 minutes. The core has a chamber *d* at the bottom, constituting a kind of diving bell, in which the water rises only as far as the hydrostatic pressure and the contracting of the confined air by cooling will allow it. The freezing takes place in regular layers from without inward; the ice at first closes the top of the space and then the solidification gradually proceeds downward and ends in the chamber, where because of the expansion an arched bottom *n* will be formed and around this a peculiar shaped inner gripping edge. In the same way the air confined in the water is forced to escape therein. The ice goblet is not removed in the ordinary way of thawing it out—such would obviously be its ruin. The mold is made of a material expanding more rapidly than ice (viz., a special metal) and the core is made of a material expanding more slowly than ice (viz., a special porcelain), so that the dilatations by heat are: $a > b > c$.

The apparatus is sunk for a while in a special heater, giving off just enough heat to the mold without transmitting any perceptible heat to the ice goblet; now this latter is instantly drawn out with the core, to which it adheres chiefly because of the gripping edge within the chamber *d*. The latter is in reality a structural part of the bell-shaped piston *e*, that is carried by a rod *f* ending in a handle *g* outside the core. On pressing the handle downward the piston expels the ice goblet, which is then caught in a paper shell. The whole operation takes but a few seconds.

About 100 ice goblets per hour can be made with one horse-power, so that only very small refrigerating machines are needed for producing considerable quantities.

Moving Pictures in Natural Colors.

Many unsuccessful attempts have been made to produce moving pictures in natural colors. The comparatively simple Lumière process is not sensitive enough, and the three-color process is too complicated. Let us first consider how a motionless screen picture in natural colors can be produced by the three-color process. If the scene is photographed through a red ray filter and a positive transparency, made from the resulting negative, is projected by red light, a red picture of the red parts of the scene will appear on the screen. A blue and a yellow partial picture can be produced in the same way, and if all three are thrown on the screen simultaneously and in exact register the result will be a picture of the scene in its natural colors, if the tints and intensities of the three monochrome pictures have been correctly chosen. It appears scarcely possible to repeat these intricate operations 16 times in a second, the rate at which moving pictures are taken and projected.

Several years ago Charles Urban made some experiments on the possibility of substituting successive for simultaneous projection of the differently colored partial pictures, on the theory that the persistence of retinal impressions applies to color as well as to form. More recently, G. Albert Smith has continued the experiments, devoting particular attention to the extension of sensitiveness toward the red end of the spectrum and to the possibility of substituting two colors for three. The experiments have been so far successful that Smith and Urban, working together, have exhibited in London, Paris, and Berlin, very satisfactory moving pictures, in approximately natural hues, using only two colors, with the aid of a colored light in projection. The colors of the ray filters are orange-red and green-blue, but their composition, and that of the projection light, are yet a secret. The negatives are made on a single film, alternately through the red and green-blue halves of a disk which rotates with the proper velocity between the film and the lens. The strip of positive film made from this negative film is projected with the aid of a similar device. Hence positives 1, 3, 5, 7, etc., of which the negatives were photographed through a red filter, are projected in red, and positives 2, 4, 6, 8, etc., from negatives made with a green filter, are projected in green. The colors of the successive pictures (modified by the special fixed color screen used in projection) are combined by the persistence of retinal impressions and approximately reproduce the natural tints of the scene. The varying tints of the red coats of soldiers drilling in direct sunlight were beautifully brought out.—Umschau.

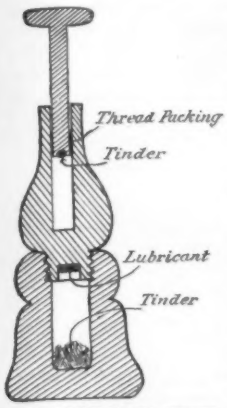
It has recently been discovered that the candelilla plant contains wax in sufficient quantities to make the plant industrially valuable. The plant rejoices in the botanical name *Pedilanthus pavones euphorbiacea*, and grows in Central America and Mexico. The wax is white in color, very hard, with high melting point.

Handy Man's Workshop

PRIMITIVE FIRE-MAKING MACHINE.

BY CAPT. JOHN G. MAC KIZER.

Some time ago the SCIENTIFIC AMERICAN published an article describing primitive methods of making fire. The accompanying sketch shows, in section, a fire-making machine which I obtained from a native in the Lobo Mountains, Batangas, P. I., and which embodies a different principle from any described in the article.



FIRE-MAKING MACHINE.

To operate it, the machine is held in the left hand, and the piston, loaded with tinder and inserted far enough in the well to insure a straight entrance, is struck home and quickly withdrawn. Some skill is required to accomplish this rapidly enough to get the spark to the air before it is extinguished. It is made of caraboa horn. The tinder is scrapings from the interior of bamboo, and the lubricant is tallow.

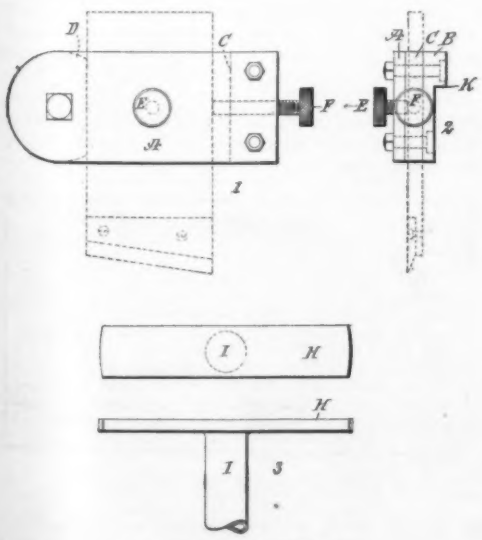
After some difficulty I induced the native, who was of the lowest type, to show me how he could make fire without his machine. Taking a large section of dry bamboo, he split off a piece about three inches wide and eighteen inches long, and cut a trough across it near one end. This trough he carefully deepened until at its middle point it just broke through. On another piece he cut a row of notches on one edge. Then scraping a quantity of fuzz from the interior of the bamboo, he pressed a bit of it through the small hole at the bottom of the trough, and laid the piece concave side down on a pile of tinder. He held this piece down with his knee, and with both hands sawed rapidly in the trough with the other piece. In a few seconds the tinder began to smoke, when he lifted the bamboo and blew the spark into a blaze. I then tried it with equal success, but have been unable to get just the right touch to pieces that I have prepared myself.

HOLDER FOR GRINDERS.

BY O. D. CARTER.

A very simple device for holding dies and other work of similar shape while grinding on small emery wheels may be made as shown in the sketch.

Between the top plate *A* and bottom plate *B* are two blocks, *C* and *D*, of sufficient thickness to allow the work to pass freely between *A* and *B*. The block *C* has a knurled screw passing through it, which firmly holds the work against the block *D*. The latter is



HOLDER FOR GRINDERS.

formed of a circular piece and may be clamped at any desired angle by means of a nut.

The knurled screw *E* holds the work against the lower plate. All bolt heads are sunk flush with the bottom plate. *H* is a suitable rest for the above clamp. Its shank *I* is turned to take the place of the ordinary rest of a small emery wheel. By raising or lowering the rest, the required clearance is obtained. When the grinding is finished, the edge of the rest engages the shoulder *K* of the lower plate *B*, thus making it certain that each piece will be ground at the same angle and length.

TOOLS FOR THE WORKSHOP.—II.

BY I. G. BAYLEY.

(*Continued from the issue of April 24th.*)

A COMBINATION PLANING AND SHOOTING BOARD.

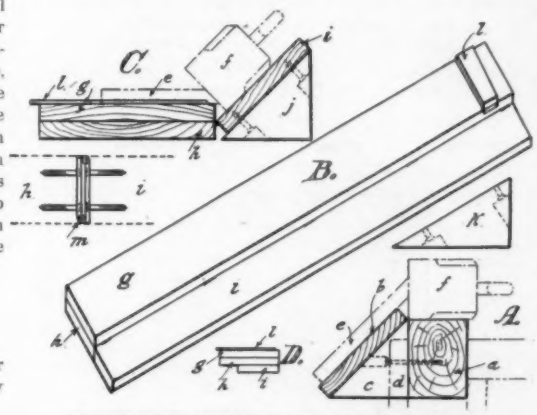
It is sometimes necessary to put a long straight or bevel edge upon a board; and while this can be done by the aid of the try square or bevel square, the board being held in the vise, the accuracy of the work depends largely upon the skill of the mechanic, and requires much practice. For the amateur, and even the professional, a board such as shown in the accompanying illustration is desirable.

All that is necessary for planing square edges only is a board about 9 inches wide, secured to one underneath, 15 inches in width, each ⅞ of an inch thick, and as long as the bench. The boards must be planed perfectly true, the working edge in particular, and a stop of some kind should be furnished at one end.

Sometimes it is necessary to plane a long miter edge on a board, in which case an ordinary shooting board, such as described, will not do.

One arrangement of shooting board for long miter joints is shown in the cross-sectional view *A*, in which *a* is a length of 3 by 4-inch timber, to which is secured a board *b*, at an angle of 45 degrees, by means of triangular blocks *c*, spaced about 2 feet apart, commencing near the ends. One end of the shooting board is held in the vise *d*, the other end resting upon pegs in the apron of the bench. The board *e*, whose edge is to be planed, is clamped to the board *b*, and the plane *f* shot along the 3 by 4-inch piece *a*.

At *B* is shown another scheme, where two 9-inch boards, *g* and *h*, are secured together by means of screws, driven in from the underside of the lower board *h*, which in turn is hinged to a board *i*, in the same plane, 6 inches wide. By means of blocks, *j* or *k*, secured to the board *i*, bevel or miter edges of 45, 60,



COMBINATION PLANING AND SHOOTING BOARD.

and 30 degrees can be planed along the edge of any board *e*, as detailed at *C*. A wedge stop *l*, of hard wood, is furnished at the far end of the plank *g*, several being made of various thicknesses, to suit the work in hand.

Before using the board, the work bench should be swept down, and it is very necessary to have it level.

Ordinary hinges for holding together the boards *h* and *i*, are perhaps best, being steadier; but for convenience when the board is out of use, if the double swing hinges *m* are used, the 6-inch board *i* can be folded under the others, as shown at *D*, the blocks of course having first been removed.

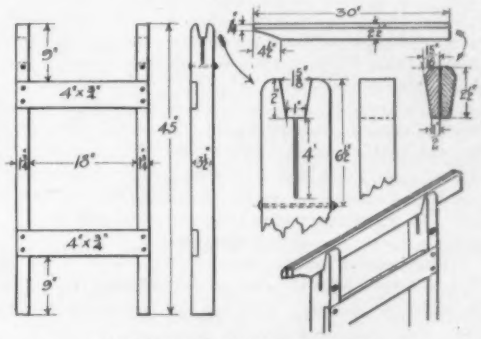
Care must be taken to place the hinges a trifle below the surface, or the edge of the plane will wear over them, as it is shot from one end of the board to the other.

THE SAW CLAMP.

The majority of saw clamps on the market are either secured to the workbench by means of a thumbscrew clamp or other adjustment, or they are held in the vise—an arrangement having several bad features, which are overcome by the clamp here described. With this clamp it is unnecessary to take out the saw, or unscrew the vise, when changing off to file the other edge of the teeth. Instead, the clamp and framework is turned around bodily. It can be moved from place to place, to a good light, or wherever most convenient, since it is not dependent upon a vise or bench for its support. The clamp being longer than the width of the vise, takes a better grip upon the saw; and the simplicity of clamping it (without the usual adjustment by means of a screw or pin) recommends it.

The framework may be made of light wood; the 4 by ¾-inch pieces being let in flush with the face of the 1¾ by 3½-inch side bars, to stiffen it. To prevent the 4-inch slot for the saw splitting down when the clamps are driven in, a bolt is put through, as indicated, 6½ inches from the top.

The clamps should be hard wood, 30 inches long, shaped out as detailed. The 4½-inch recess, to allow for the saw handle, should be cut when the two clamps are together, since this makes them right and left handed. When making the two clamps, the taper should be obtained before the edges are rounded off, as shown in broken lines.



CONVENIENT CLAMP FOR SAWS.

The lower right-hand corner sketch shows the clamp in the framework without the saw. When necessary to set a saw, it is dropped in the 4-inch deep slot, teeth up, the two clamps wedged into place on each side of it being driven home with a mallet or hammer.

(*To be continued.*)

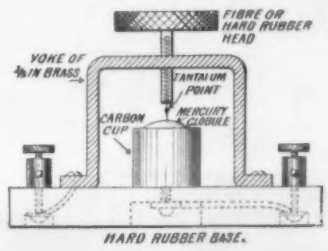
A TANTALUM DETECTOR.

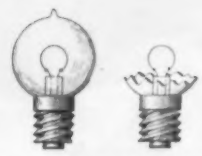
BY ALFRED P. MORGAN.

A detector for wireless telegraphy has recently been devised, which makes use of a tantalum wire or filament in contact with a globule of mercury. While this detector is not so sensitive as the electrolytic or silicon type, and will not respond as well to very faint signals, it more than makes up for this when used for detecting signals of ordinary strength. It will then give tones several times as loud as either of the two types mentioned, and does not require the use of high-resistance telephone receivers. Its normal resistance is about 1,500 ohms, which drops as low as 250 to 270 when struck by oscillations. The construction of such a detector is quite simple and well within the ability of the amateur. The first operation is to secure the tantalum wire. This may be taken from a tantalum lamp of the battery type. A deep scratch is made in the glass all the way around the base of the globe by means of a small three-cornered file moistened with turpentine and camphor. A second scratch is made from the base to the tip on both sides. A light tap will then break the globe in two. Do this carefully lest you break the filament.

Cut the filament off within about 1/16 of an inch from where it is joined to the platinum or iron wires. This can best be done with the points of a small pair of scissors. Then break the small glass stub which holds the wires in place, so as to secure the tantalum with about ¼ inch of wire fastened to it.

A screw in which to fasten it so as to permit of adjustment may be taken from the carbon of an old dry cell. A fiber or hard-rubber washer will make a good head for the screw. Bore a 1/16-inch hole in the end of the screw. Make it about ⅛ of an inch deep.





HOME-MADE TANTALUM DETECTOR.

Place the end of the wire opposite the tantalum point in this hole, and pack tinfoil around it with the head of a sewing needle, or if preferred fasten it to the screw by means of a small drop of solder.

The cup is best made from a piece of carbon rod. Remove the rod from an old dry cell, and saw off a piece about an inch long from the end containing the brass connecting cap. Then trim off all the rough edges of the carbon with a coarse file. A hole ½ inch in diameter and ¼ inch deep should be bored in the

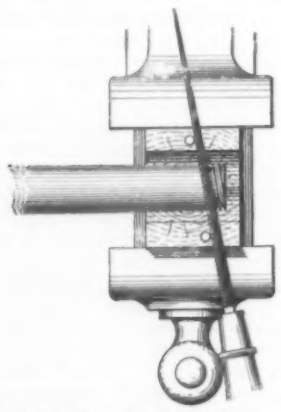
center of the rod at the end, forming the cup for the mercury. Bore a ⅛-inch hole through the base where the cup is to be fastened, and countersink it to ½ inch in diameter from the under side. This enables the brass nut to be put on the under side, thus serving both to hold the cup firmly in place and as a connection for a wire to the binding post. This is shown by dotted lines in the drawing. The yoke is made of a piece of sheet brass. Two holes are bored in the feet, and it is fastened to the base by means of screws. A hole is bored and tapped to receive the screw point. If a tap is not to be had, a ¼-inch hole may be bored in the yoke, and a battery nut soldered directly over the center of the hole.

The detector is best mounted on a piece of ½-inch hard rubber measuring about 3 by 4 inches. Four binding posts will be required for the usual connections.—Electrician and Mechanic.

THREAD CUTTING WITHOUT A DIE.

BY J. A. BERGSTROM.

It sometimes happens that the threads of a bolt or a pipe break off and must be cut without the aid of a screw-cutting die. This can be accomplished very



THREAD CUTTING WITHOUT A DIE.

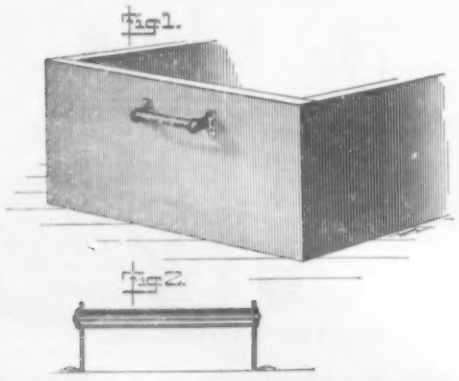
easily with the aid of an ordinary half-round file and a little patience.

Take a block of wood and fasten it in a vise. Make a V groove in the block deep enough for the center of the pipe to come a little below the surface. If the pipe is long, it will be better to make two of these blocks, so as to keep it steady. Now into this groove place a pipe with thread same as wanted, and on one side of the block drive in a nail. Place the flat side of a half-round file against this nail and see that it forms the same angle with the pipe as the thread does. Then drive in another nail on the opposite side of the block, so that it will touch the flat side of the file. Now remove the pipe and replace with the one to be threaded. Hold the file with the smooth side against the nails and while filing keep turning the pipe. The pipe should be rocked backward and forward. That is, to say, on the forward stroke of the file turn the pipe in the opposite direction, thereby insuring a much better thread.

A SIMPLE METHOD OF CONSTRUCTING A HANDLE.

BY W. C. M'KENZIE.

The accompanying illustration shows a simple method for constructing a neat and strong handle for a box, or a drawer. The handle is fashioned from two similar shade roller brackets which are fastened in place by means of screws at the points where the handle is needed. A piece of pipe or tubing is posi-



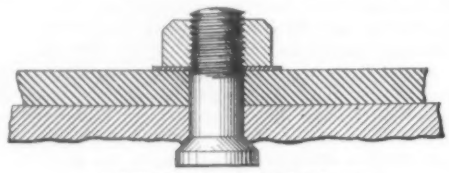
SIMPLE METHOD OF CONSTRUCTING A HANDLE.

tioned between the brackets and is held in place by a stiff wire or other rod which passes through the tubing and the openings in the brackets, having the ends hammered down or riveted at the outside of the bracket. The tubing may be of brass or any other suitable material adapted for the purpose, and preferably tending to add to the appearance of the handle. The ends of the tube should be inserted in the concavities of the brackets, as is shown most clearly in Fig. 2.

METHOD OF PATCHING A BOILER.

BY JOHN W. E. LAKER.

The following method of bolting a patch on a boiler perhaps shows some originality. It was required to patch the bottom of a combustion chamber



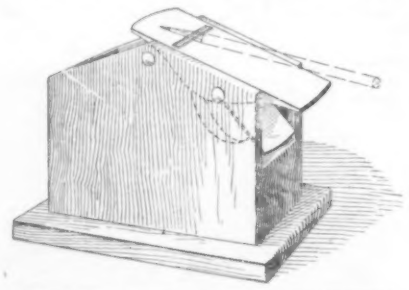
BOLTING A PATCH ON A BOILER.

of a very old boiler, badly pitted on the water side. Riveting was impossible for want of space. The patch was five feet by two, fitted on the fire side, and the greatest difficulty to overcome was to make the bolts watertight, owing to the impossibility of driving them or getting a contact under the heads against the bad plates. Gaskets did not appeal to the repairer, and a metallic contact was aimed at. This was accomplished by making each bolt act as an ordinary miter-seated valve. They were turned a hand-workable fit (all but the last ¼ inch, which was tight) to reamered holes of steel, and case-hardened, fitted in from the water side, and hammered up with a spanner. The "seat" was sunk into the boiler plates. There were altogether 128 bolts in the patch. The job when finished passed a government surveyor's examination, and steamed from Honolulu to San Francisco without mishap.

PENCIL SHARPENER.

BY JOSEPH N. PARKER.

I have to provide means for the sharpening of one hundred or more pencils daily, and after having tried with little success a number of the expensive sharpeners, I fitted up a small all-metal carpenter's plane in a box, and it answers the purpose admirably. After a little practice one can easily make any kind of a point desired. The bit will stay sharp long enough to point several thousand pencils, and then it can easily be re-



CARPENTER'S PLANE AS PENCIL SHARPENER.

moved for sharpening. The accompanying sketch shows how it is done.

Shavings from pencils are excellent for driving away moths.

COPPERING FLOWERS WITHOUT WAX.

BY ARTHUR E. HAGARTY.

The writer is interested in electroplating flowers, etc., and has had considerable success in coppering and silvering, using no wax. The rose (or other article) is dusted over with the finest graphite (blow the excess off) and immerse in the copper solution. An ordinary rosebud is thickly and sufficiently plated in about fifteen hours, using six large-sized gravity batteries. Of course the silvering and gilding are easy after a good coat of copper has been deposited. The wax is unnecessary except to stiffen the petals or when glass, etc., is to be plated.

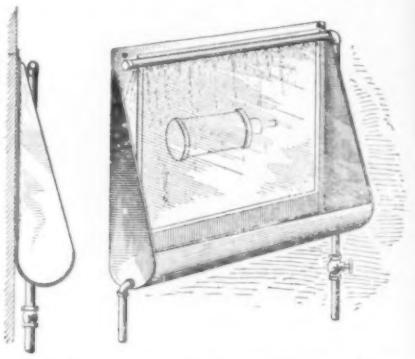
Some beautiful rosebuds have thus been plated in copper and silver, with the stalks, etc., enameled green. Undoubtedly many amateurs would like to experiment with this work, if they knew it was so easily done. A stout copper wire is pointed with a file and carefully drilled (by hand) into the center of the lower part of the bud, care being taken not to break off the small green petals. After dusting well with the graphite the wire is thrust through a piece of heavy cardboard as a handy means of adjusting in the plating bath, which should be about ¼ inch above the flower. The wire is then connected, and in a few minutes the copper can be seen creeping over the petals. The flower should not be disturbed till entirely plated. Of course the flower can be put in any position, but the vertical position is the best, because the petals tend to float out of position when inverted. The wire can be bent in the form of a large hook with the point upward, but this makes unnecessary and wasteful surface to plate with a small battery. All the plating should be concentrated on the flower, if possible. The finished flowers should be polished for bright effects, and well rinsed in hot water, or boiled, to get rid of the acid, which would otherwise corrode.

Some very beautiful effects can be obtained with ferns, etc. Anything can be plated which is not affected by the acid during plating. To deposit on glass it must be coated with paraffin first, all the excess of graphite being brushed off.

BLUE-PRINT WASHER.

BY W. J. C.

A very compact blue-print washer, which has the great advantage not only of taking up very little space, but also of permitting the washing to be done without the usual slopping over and dripping incidental to the use of tanks, can be made very cheaply of galvanized iron, as shown in the accompanying sketch. The washer is attached in a vertical position on the wall, and the pipe furnished with valve running up the side and across the top. The last piece of pipe, the horizontal, is drilled with one row of holes 1/16 inch diameter about 3 inches apart, and so placed that the water strikes the back of the washer at an angle of about 45 deg. To wash a print,

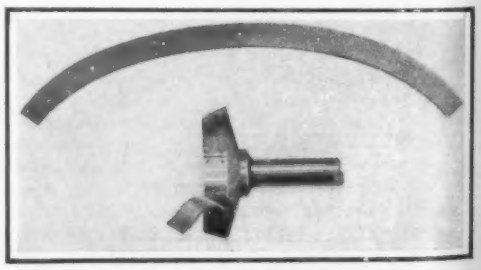


A VERTICAL BLUE-PRINT WASHER.

the water is turned on for a moment, wetting the back of the washer, and then shut off and the dry print stuck up on the wet surface. Care should be taken that the top edge of the print comes slightly above where the water strikes, to prevent the print being washed down by water getting back of it. The water is then turned on, and a thin film of water allowed to run over the face of the print. If there is no trimming space left on the print, it can be turned upside down after a few moments, to insure the top edge being washed evenly. This method washes prints in a very short time, as the running water is much more effective than the tank method. Painted with aluminium paint, the washer looks well in any office, and will save its small cost in a very short time.

PUTTING ON A NEW CLUTCH LEATHER.

A clutch leather may be cut from a wide piece of leather belting of uniform thickness, usually ¼ inch. If the piece chosen is too thick, it will be impossible to release the clutch fully. Take off the old clutch leather, lay it out flat, and use it as a pattern for the new leather. (See cut.) As the leather will stretch somewhat, it is not essential to have the new leather curve as much as the old one. Cut the new leather about ½ inch short, and punch and countersink holes in its ends for the rivets, whose heads should be below the surface of the leather. Soak the new leather in water until it is thoroughly soft. Stretch it over the clutch, and put temporary rivets in the ends. Mark the central rivet hole, remove from the clutch, and punch that hole. Put the leather on



PUTTING ON A NEW CLUTCH LEATHER.

the clutch again with temporary rivets, and punch and mark the remaining holes. When all have been punched and countersunk, rivet the leather in place. For this purpose it is necessary to have a bar whose end diameter is about the diameter of the rivet heads. This bar is used as an anvil against the rivet heads. Two men are necessary, and the whole job, after the leather has been taken out of the water, must be done quickly, else the leather will shrink so that it will not go on.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

POLE.—W. ROBERTS and C. ROBERTS, Springfield, Ohio. The invention relates more especially to such poles as are used for stringing electric circuit wires and the like. The pole can be braced equally on opposite sides, when for example, the pole is inclined on curves and the like. The device is adapted removably to carry a mast and cross-arms upon which the wires are strung. Messrs. Roberts have invented another pole or standard formed from concrete or other plastic substances adapted subsequently to harden, and having reinforcing tension members imbedded or partially imbedded therein, T-iron or similar elongated members, and having annular holding members encompassing the tension members, the poles being formed in sections secured together by a connection of special form.

WIRE STRETCHING AND SPLICING DEVICE.—P. O. LARSON, Kellys, N. D. The invention refers to devices for stretching and splicing broken telegraph and telephone wires, and is designed to do away with the necessity of using clamps, pulleys, etc., now commonly used for this purpose, which becomes necessary when wires are cut, or broken by accident, accumulation of sleet, etc.

Of Interest to Farmers.

DRAFT-EQUALIZER.—H. C. SCOTT, Ritzville, Wash. The aim of the invention is to provide an equalizer arranged to distribute the load to be hauled equally to the animals in the team, to reduce the friction of the working parts to a minimum, and to provide a comparatively short but very strong and durable equalizer not liable to get out of order nor cause entanglement of the animals when in use.

Of General Interest.

ANCHORING-BASE FOR POSTS.—P. T. BAILEY, Middletown, R. I. The base is capable of being readily placed in position, and one wherein when the base is in position which is within the ground, will be firmly and immovably anchored, while that portion above the ground, and which is adapted to receive the post, will admit of vertical adjustment of the post and also lateral adjustment of the post in any direction necessary to bring it in proper alinement.

METAL STAIR.—C. F. STEIBER, New York, N. Y. The invention especially relates to staircases which are formed of metal. The intention in this instance is to produce a staircase adapted to be formed of steel or similar material, and the invention relates especially to the form of the separate parts and the manner in which the stairs are built up therefrom.

GATE.—C. A. EIDSMOE, Beresford, S. D. One object here is to provide a swinging gate which may be adjusted to any degree of inclination above or below the horizontal, and retained in such adjusted position. Another object is to provide a gate comprising an adjustable frame, pivoted at one end to a post and having its free end adapted to be raised or lowered, and means for retaining the frame in its adjusted position.

SUCTION DEVICE FOR AIR, GAS, OR SMOKE PIPES.—A. CAUCHEMONT, 17 Rue de l'Aqueduc, Paris, France. The air in entering the apparatus at one of the openings reaches a pipe tangentially. This air produces a suction effect inside this pipe and the smoke, gases or vitiated air escape through the openings and pass to the annular space comprised between the pipe and the strips of the lantern. Owing to the relative vacuum produced by the wind at the rear of the apparatus, the smoke or gases are drawn outside in passing through the apertures in the lantern.

SUSPENSORY.—G. C. JOHNSON, Dillon, S. C. This suspensory embodies a scrotum support, and a waterproof attachment thereto of novel construction, which forms a receptacle for the member and affords convenient means for the introduction and discharge of liquid medicaments for the treatment and cure of a diseased organ.

Hardware.

COMBINED LEAF-CLIP AND LINE-MARKER.—E. A. BAGBY, Louisville, Ky. This spring-actuated clip is especially adapted to clamp upon a leaf of a book or manuscript, and also to grip the flat end of a flat lining strip having parallel side edges, so as to hold said strip extended across or lengthwise of the leaf or page and be disposed adjacent to a selected line thereon; and for changes in adjustment for locating the straight edge of the liner strip close to lines on the page successively, to facilitate the correct posting of accounts or transfer of statements, and executing work requiring exact reading of written or printed lines consecutively.

WIRE-FENCE TOOL.—B. B. WOOD, Helena, Mont. In the present patent the invention is an improvement in tools for use in building wire fences, and it has for a particular object the provision of a novel construction whereby to apply to the crossing wires of wire fences the clamp covered in a former patent granted to Mr. Wood.

SOCKET FOR SASH-CORDS.—F. DEGIORGIS, West Hoboken, N. J. The invention pertains particularly to means for use in securing cords to a sash, or for holding a sash cord when the sash is disconnected, as for instance when the window is being cleaned. The object is to provide a socket which greatly facilitates the attachment or removal of the cord but which is constructed in such a way as to effectually prevent any accidental displacement of the cord.

LEADER-BRUSH.—M. BLACKMAN, Jersey City, N. J. The object of the inventor is to produce a brush especially adapted for use in painting the inner side of leaders or rain spouts. In the operation of the device, it will feed small quantities of paint from the reservoir to the brush, and the parts are so arranged as to enable the device to turn the corners or bends of a leader.

Heating and Lighting.

GAS-METER.—W. F. ETZEL, Lowell, Mass. This invention relates to dry gas meter having alternately expanding and contracting measuring chambers. The object is to provide improvements in meters, whereby gas passes freely through the parts of the slide valve seats to and from measuring chambers, thus reducing the decrease of the gas pressure, incident to its flow through the meter, to a minimum.

Household Utilities.

BRUSH.—C. W. PATRICK, Phoenix, Arizona Territory. This brush is primarily intended for the bath, although with slight modifications it is adapted as a scrub brush for floors, wood-work, windows and scrubbing in general, where quick thorough cleaning is desired with the least possible exertion. For the bath, the brush has all the advantages enumerated when used as a scrubbing device, in addition to presenting a sanitary article effecting its own cleaning when in use.

INSECT-EXTERMINATOR.—MARGARET E. COCHRANE and J. J. COCHRANE, Jersey City, N. J. In this case the improvement refers more particularly to exterminators adapted to be used for destroying bed-bugs or the like, and each of which in general consists of a burner adapted to have one end connected to any suitable gas supply, and a pan movably carried by the burner and serving to receive the dead insects.

BATH-TUB ATTACHMENT.—NELLIE L. GILMORE and M. GILMORE, Phoenixville, Pa. This invention is an improvement in frames for use in application to bath tubs. The aim is to provide a frame which can be applied to and removed from the tub, and will afford facilities for holding a wash bowl and a soap dish. It will be found useful for general use, but especially so in boarding houses among the laboring classes.

MOP-WRINGER ATTACHMENT.—W. F. MCGLAUGHLIN, Denver, Colo. The purpose of the inventor is to provide a construction, wherein the mop may be twisted to express the water therefrom, without the necessity of using the hands in direct contact therewith. When the cloth has been sufficiently wrung, the motion of the handle is reversed to bring the cloth into its original position, after which the operation may be repeated.

Machines and Mechanical Devices.

PENCIL-MAKING MACHINERY.—F. P. DORIZZI, 66 Elm Grove Road, Barnes, Surrey, England. Mechanical means are provided for inserting the leads or other material preferably with the combination therewith of gluing means. Leading means comprise a series of hoppers arranged over a suitable bed along which the grooved boards to be leaded are slid and means connected to each of said hoppers for feeding a single lead or strip of other material to each groove in the board at the required moment.

PNEUMATIC HAMMER.—V. E. LANE, Berwick, Pa. Among the objects of this invention are the provision of a powerful downstroke in connection with a cushioned backstroke, to render the hammer, as far as practical, independent of specified pressure of air in order to make it operative; to facilitate the removal and replacement of the barrel; to improve lubrication of movable parts; to hold the rivet-set securely at the end of the barrel, to prevent accidents and the set from falling out.

SCREW-CUTTER.—A. R. WEISZ, New York, N. Y. The invention has for its object the provision of a screw cutting device which is simple in construction, effective in operation and durable in use, adapted to be readily sharpened, and so constructed as to be capable of being accurately adjusted to screws of different diameters.

CARRIAGE-DRIVE.—J. J. SULLIVAN, Eagle Mills, Ark. The invention is particularly useful in connection with saw-mill carriages and the like. An object is to provide a support for the piston rod of a carriage drive, so that the piston rod is prevented from sagging and thereby wearing the stuffing-box and other parts with which it comes in engagement, in an irregular manner.

LACQUERING-MACHINE FOR CANS.—C. B. HANTHORN, Portland, Ore. The invention refers to a machine for the purpose of lacquering cans. The object is to produce a machine which will operate automatically to receive cans which are fed to it, in such a manner that the cans will be dipped in a bath of lacquer and dried before delivery from the machine.

FIRE-ESCAPE.—J. HEGEDUS, New York, N. Y. The object of the inventor is to provide a fire escape for permanent use on buildings, and arranged to allow repeatedly using the device for conducting people from any one of the floors of the building safely to the ground, and to permit the use of the device by firemen or others, for ascending to any one of the floors.

LINOTYPE-MACHINE.—C. ALBRECHT, Charlottenburg, Germany. One object of the invention is to provide means for reducing the wear and tear on the lugs of the matrices as they leave their magazine and enter the vertical channels. Another object is to improve upon the construction of the part or chute between the delivery mouth of the magazine and the vertical channels, particularly in machines designed for a plurality of magazines and where, therefore, the said part or chute is made movable.

Prime Movers and Their Accessories.

BALANCED VALVE.—W. ORD, Brooklyn, Ohio. The intention in this case is to provide details of construction for a valve which are practical and very efficient, and that enable the balancing of pressure on the body of the plug valve, so that leakage around the valve will be prevented, and the valve body be adapted for convenient adjustment to control the passage of fluid throughout.

Railways and Their Accessories.

RAILWAY-TIE AND RAIL-FASTENER.—P. E. FETTER and W. A. STICKLEY, Kenmare, N. D. One purpose of the inventors is to practically provide a construction of tie that will prevent shifting in the road bed, and to provide a smoothness of track that will lessen resistance, thereby saving property, and also to provide a rail lock that will hold the rails more firmly than spikes, and admit of the necessary expansion and contraction of the rails.

Pertaining to Recreation.

ROLLER-BOAT.—R. E. SHARP, Newaygo, Mich. In this patent the invention relates to small pleasure boats or launches, and the object of the inventor is to produce a boat having a simple construction which will be economical to build, and having improved propelling mechanism and improved steering gear.

Pertaining to Vehicles.

COMBINED HEARSE AND PASSENGER-VEHICLE.—F. HULBERG, New York, N. Y. The invention has reference to power-driven vehicles, such as automobiles, and its object is to provide a new and improved combined hearse and passenger vehicle, arranged to accommodate a coffin and flowers in one compartment and passengers in a separate compartment.

COMBINED ODOMETER AND SPEEDOMETER.—R. G. SANFORD, Yonkers, N. Y. The invention has for its purpose to provide for the actuation of the measuring means in the same direction, irrespective of the direction of movement of the part measured; to dispense with the usual flexible shaft such as is employed when the meter is applied to a vehicle, and in general, to provide a construction having little or no tendency to vibrate.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12076) F. E. S. says: I am inclosing a copy of a report on the efficiency of a new kind of quadruple engine which is being built and placed on the market by a local concern. With 3.5 gallons of kerosene they developed, by brake test, 52 horse-power constantly for one hour. I am unable to find any efficiency tables for steam engines using kerosene for fuel. Can you tell me what the best machines now on the market do deliver? 3.5 gallons of kerosene develop 52 horse-power for 1 hour; 3.5 gallons kerosene weigh 23.57 pounds; 1 pound kerosene has 21,000 B. T. U.; 23.57 pounds kerosene have 494,970 B. T. U.; 494,970 B. T. U. equal 385,086,660 foot pounds; 52 horse-power is 102,960,000 foot pounds per hour. Fraction of the energy in the oil which is delivered by the engine is $\frac{102,960,000}{385,086,660}$ or 26.74 per cent. A. You are unlikely to find tables of combined efficiencies of engines and boilers using oil fuel because the method of testing the efficiency of an engine by the fuel consumed under the boiler had come to be considered an unfair criterion before much advance had been made with liquid fuel. There is no analogy whatever between the terms engine horse-power and boiler horse-power, the latter being an unsatisfactory term only used for want of a better. That the capacity of the accompanying boiler depends upon the relative efficiency as well as the capacity of the engine may be shown by the fact that a single-cylinder non-condensing engine may take as much as 30 pounds of steam per horse-power per hour, whereas a modern triple-expansion condensing may require as little as 10 pounds. At the same time your comparison of the power delivered in useful work with the B. T. U. contained in the fuel consumed is a perfectly legitimate one, and your figures are apparently correct. The figures are certainly unusually high, the best we know of, for any kind of fuel shows an efficiency little more than half as high based on fuel consumption per horse-power.

(12077) J. V. A. asks: I am seeking information on the question of water power. I wish to utilize the water in a stream running through a flat country, with hills about 300 to 400 feet high on both sides, but these hills are not the source of the creek's supply. Could you put me in communication with some one, or a firm, who could advise me as to the best method of obtaining from 12 to 15 horse-powe from this creek, by hydraulic ram, to elevate water to the hills nearby to drive Pelton wheel, or undershot current wheel, or Poncelet's undershot wheel by damming up the creek, or any other method that may suit? You may be in a position to answer this question; if so, please let me know. I would require full details and plans of wheels, their construction and application to the creek, etc. (I wish to construct the wheels myself, if possible.) I am only a novice at using water power. The machinery I wish to operate from the stream is a Sisal hemp decorticating machine, and possibly a small circular saw. I inclose a rough sketch of cross section of creek, and some figures which were obtained at the same spot, which is a suitable one for the erection of the machinery in the event of your undertaking this question. A. Your method of measuring the flow of the water is quite reasonably approximate and, making due allowance for error and variation of the flow, we should say that you have just about enough water to generate 15 horse-power in the manner you suggest. A good Pelton or similar impact waterwheel should deliver 75 per cent at least of the theoretical power in a given fall of water, so for 15 horse-power you should have a fall and quantity of water with a theoretical power of 20 horse-power. The formula is $H.P. = 0.00189\,Q\,H$, in which Q = quantity of water in cubic feet per minute and H = head in feet. Supposing you lift your water with a ram to a height of 100 feet above the stream,

$$20\ (H.P.) = 0.00189\,Q \times 100 \text{ or } Q = \frac{20}{0.189} =$$

106 cubic feet per minute nearly. A good ram with not more than 100 feet conveyance will lift about 1/14 of the water required to operate it to a height ten times that of the fall required to operate it, so that 106 cubic feet of water could be raised 100 feet by $14 \times 106 = 1,484$ cubic feet of water with a fall of 10 feet. Your flow at the rate of 66 feet in 15 seconds of a stream 11 feet wide and 7 inches deep represents 1,694 cubic feet per minute, so that you have a fair margin. The length of the drive pipe does not matter, provided you have the whole of the water required to drive the ram inclosed in a pipe for the whole height of the necessary fall, i. e., the dam need be only 5 feet high if there is a further fall of 5 feet from its foot to the point at any convenient distance downstream where the ram is situated. We should say that you could not get the requisite power with a current wheel, as its efficiency is extremely low. With a Ponceiet or, better, a low-head turbine, you could, but we should say the first cost of dam and equipment would be higher.

(12078) H. R. P. asks: Will you kindly answer the following questions? What is meant by the term cycle in relation to gas engines? Why is an engine which makes two revolutions to every explosion called a four-cycle engine? How is it possible for any engine to have more than one cycle? A. The "cycle" of any engine is the complete sequence of operations gone through by the operating fluid; in the case of gas or other internal-explosion engines it consists of inspiration during one stroke, compression during one stroke, ignition, explosion, and expansion during one stroke, and exhaust during one stroke. The terms "four-cycle" and "two-cycle" are misleading, and should more properly be "four strokes to the cycle," etc., in fact on this account the term "four stroke-cycle" is now coming into use. In two-cycle engines, either by exploding the gas on both sides of the piston or otherwise, the two separate cycles overlap each other, and whereas each is exactly the same as in the four-cycle engine, one or other cycle is completed every two strokes. The term "two-cycle" has, however, the alternative sense that two separate cycles are used in operating the engine and, therefore, though a later term than "four-cycle" and derived from it, is less inaccurate.

(12079) J. S. asks: Kindly tell me in your Notes and Queries column how to produce extreme cold by means of carbonic acid gas and ether. I have tried letting the gas run into a bag which has been wet with ether. I understand this to be the method. The result should be a kind of frappé effect to use for a freezing mixture. A. Carbonic acid gas has no action upon ether. No lowering of temperature would be expected from passing the gas through ether. If liquid carbon dioxide is allowed to escape from a tube into a bag, some of the liquid will be frozen and solid carbon dioxide will be found in the bag. Place this in a porcelain crucible and pour ether into the crucible. A pasty solution of ether and the solid is formed with a great drop in temperature. Tyndall's "Heat as a Mode of Motion," which we send for $2.50, gives many experiments with solid carbon dioxide.

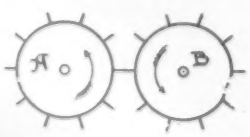
(12080) M. A. C. says: 1. In evaporation, does the water vapor formed crowd back the air? A. Carhart's "University Physics," vol. 2, will give you a correct view of the process of evaporation. There is no pushing back of the air by the molecules escaping from the surface of the water. There is plenty of room for them between the molecules of the gases of the air. 2. Does the air offer any resistance to evaporation of water? A. The air offers great resistance to the escape of water molecules into it—15 pounds to the square inch. In a vacuum water evaporates with violent boiling. It is the pressure of the atmosphere which keeps the water in the liquid form upon the earth. Otherwise all water would be in vapor in the space about the earth, as the air now is. 3. What is the best explanation of just how evaporation produces cold? A. The only explanation of evaporation is that heat changes water into vapor. The heat used for this work does not affect a thermometer, and is called the heat of vaporization. Since this heat must come from some other body, the surrounding bodies are made colder by the abstraction of heat from them to change the water into vapor. 4. Heat is defined as molecular motion. Does that mean that the amount of heat depends on the number of molecules striking a thermometer as well as their velocity? A. The more rapid the molecular motion, the higher the temperature of a body. More molecules would then strike a thermometer in a second, of course. They would also strike with a higher velocity. 5. In the expansion of gas against pressure, which is affected, velocity or number of molecules, in the change of temperature? A. In the expansion of a gas against pressure the velocity of the molecules is changed, and therefore the number of molecules per second passing a given point will also be changed. 6. Will you discuss the question if the expansion be into a vacuum? A. The expansion of a gas into a vacuum does not produce any cooling effect, since the expanding gas does no work in expanding. 7. What is the best explanation of a mixture of salt and ice producing cold? A. There is but one explanation of the action of salt and ice as a freezing mixture. The melting of the ice and salt is caused by the heat absorbed from the article to be frozen. The heat required to melt ice is very large, 80 calories per gramme. 8. What is the best explanation of rain being produced by a current of air striking a mountain? That is what cools the air? A. Warm air can hold more water vapor than cold air. When a warm current strikes a cold mountain side, the chilling of the air reduces its capacity for moisture and saturation is soon reached, after which the formation of rain drops begins. All these questions are treated in good textbooks of physics under heat. If you have not the Carhart referred to above, we can send you a copy for $1.75 prepaid.

(12081) A. E. W. asks: 1. Would you explain what is meant (when giving the caliber of small arms) by two numbers, as 45-90, 30-30, 25-20, and 56-50? I understand that there is a big difference in the size of calibers mentioned, and that the 25-20 is a bottle-shaped cartridge, but there is no apparent difference in the diameter of shell and ball of a 56-50. A. In giving the caliber of small arms by two numbers, 45-90, the first number stands for the caliber expressed in decimals of an inch (in your case 0.45 or 45/100), the second the number of grains of powder used in the charge. In the case of the 25-20 gun, the 25 stands for a repeating rifle, the 20 for a single shooter. The weight of the bullet is the same in both cases, but the repeater cartridge is enlarged to take a larger charge of powder. 2. What does the number giving the gage of shotguns mean? What part of an inch are they, or do they not represent some part of an inch or foot, 10, 12, 16, and 20 gage? A. The gage of the shotguns, as 10, 12, etc., is a survival of the old-fashioned nomenclature. In early days it was customary to find out how many spherical balls went to the pound weight. If 10, the gun was called a 10-gage gun. 3. Ice manufactured by a process, where cans of water to be frozen are immersed in a tank of brine, cooled by pipes carrying ammonia, there often appears a place in the center of the cake that is white or nearly opaque, sometimes looking like very small air bubbles. Would you explain the cause of the ice not being clear at the center as it is at the sides of the cake? I have been told that it was ammonia in the water, and some even claim that they can taste it, but I cannot see how that can be when the ammonia is confined in the pipes. I think it is a defect in the freezing. A. The white or semi-opaque place in the center of cakes of artificial ice is nothing more than what you say it looks like—air bubbles. The process of freezing excludes suspended air from the water, leaving it in the form of bubbles (as it often appears in natural ice) if steps are not taken to prevent it. In the can system of artificial ice making, the water is agitated while freezing to get rid of the bubbles, and as the ice forms from the outside inward, the outside and bottom end of the cake is generally clear. Sometimes, however, the agitation is not kept up long enough, as the block becomes nearly solid, and an accumulation of bubbles remains in the center near the top. You will notice that the white part you speak of is always at one end of a whole cake—the end which was uppermost as it stood in the can. There is no possibility for the ammonia from circulation pipes to reach the cans, the freezing of the latter taking place in brine, not ammonia, and elaborate tests of the purity of the ice water are regularly made in every properly conducted plant. The occurrence of this white core in plants using distilled water (from which the air is removed) as many now do is a sign of imperfect distillation or filtration, but not of such impurities as your friends suggest.

(12082) L. M. K. asks: 1. A tank of 5 cubic feet capacity is filled with a gas at 200 pounds pressure. How many cubic feet of gas will there be at 1 pound pressure? A. The answer to your first query is figured by the formula $P_1 V_1 = P V$, representing Boyle's law that the pressure of any gas is inversely as the volume and *vice versa*. In your case $P_1 = 1$ pound, $P = 200$ pounds, and $V = 5$ cubic feet. Substituting: $1 \times V_1 = 5 \times 200$, or $V_1 = 1{,}000$, i. e., a gas having a volume of 5 cubic feet at 200 pounds pressure (185.3 gage) would have a volume of 1,000 cubic feet at 1 pound pressure, or 13.7 below atmosphere. The above are absolute pressures, which must be used for the solution to be accurate by the formula; if you use gage pressures (pressures above atmosphere) add 14.7 pounds to both pressures before substituting in the formula. 2. To what pressure is it safe to compress a gas? A. A gas may be compressed to any amount according to circumstances, strength of container, temperature, etc., which you do not mention. All gases can be liquefied by sufficient pressure, their pressure becoming greatly reduced by liquefaction. 3. At what pressure is illuminating gas delivered to the consumers? A. Illuminating gas for domestic purposes is delivered at about half a pound pressure above atmospheric.

(12083) C. S. R. says: If a coiled spring made of pure iron is placed in a bath of hydrochloric acid, the spring dissolves, and ferrous chloride would be formed according to the following equation: $Fe + 2HCl = FeCl_2 + H_2$. Heat would be evolved as a result of the chemical action, and the chemical energy would be changed into heat energy, about 80,000 calories being developed per unit each substance. The solution thus far is clear, but here is the difficulty: Take the iron spring and compress it and tie it with some thread so that it remains in a compressed position. The spring now possesses potential energy as a result of this compression. Now place the spring, in this compressed position, in the HCl as before; the iron will dissolve as before, the spring all the time remaining compressed, because the thread is not acted on by the HCl. The question now rises, What has become of the potential energy the spring possessed? A. It appears to us that under the conditions you name there would be a liberation of heat in consequence of the tension of the spring. That is to say, if you provide two equal quantities of acid, and dissolve therein two springs exactly alike except that one is wound up and the other is unwound, there will be a greater liberation of heat by the dissolution of the spring under tension than of the other spring, the difference in heat representing the thermal value of the energy used in winding the spring. This question is very interesting, and has been discussed in our columns heretofore. We think it can be determined only by a careful experiment, coupled with quantitative measurements of the heat developed.

(12084) G. H. H. asks: I have here a mechanical problem, the solution of which I would like to see in your query column. Suppose we have two disks of equal diameter, each having ten blades projecting at equal



distances around the rim, as shown in above sketch. Now if one disk is made to revolve 10,000 R. P. M., while the other is stationary and in a position where one of its blades would come in contact with each of the revolving blades, there would be 100,000 contacts made per minute. Now if both disks were revolved in opposite directions, at exactly the same speed, 10,000 R. P. M., would the number of contacts remain the same, or would they be increased, and if so how much? A. Since by revolution of the left-hand wheel *A* at the same speed as that of the right-hand wheel *B*, each of the ten teeth of *A* touches one tooth of *B* once in every revolution, instead of only one tooth of *A* coming in contact with the teeth of *B*, as when *A* was still, it would appear at first sight that there should be ten times as many contacts as before; but whereas before one tooth of *A* was touched in each revolution of *B* by every tooth of *B*, now one tooth of *A* touches in each revolution only one tooth of *B*. The total number of contacts is therefore multiplied by ten and divided by ten, and remains the same.

(12085) E. M. S. asks: 1. Where does the largest supply of pearls come from? A. The best pearls as well as the largest quantity come from fisheries around Ceylon: see our article of April 24th. 2. How is a pearl valued? A. Pearls have a certain minimum value by weight above which their value varies more than that of any other gem through quite arbitrary conditions of form, color, perfection of "skin," lack of irregularity, etc. 3. Can pearls be made artificially? A. Imitation pearls are now made so well as to be detected with difficulty but are not identical chemically or physically with natural pearls as are artificial diamonds or rubies. 4. Does the voltage or the amperage destroy life in electrocution? A. A high voltage is required but as generally understood a fairly high amperage is the more essential. A very small current at 5,000 volts pressure may be taken with impunity from an induction coil whereas persons have been killed by large currents at pressures as low as 500 volts. 5. What is the meaning of the terms "cycle" and "frequency" in electricity? A. A cycle is one complete series of changes of the electromotive force in an alternating current. The voltage rises from zero to its plus maximum and falls through zero to the same negative value and back to zero in each cycle. The frequency is the number of complete cycles in a second. 6. Is there any difference in color between the water of the Red Sea and that of the Mediterranean? A. We should say that the difference is largely imaginary except in so far as the color is influenced by depth and the character of the bottom, which, in the Red Sea, is largely coral. 7. How many vessels pass through the Suez Canal? (8) Do they go through at night? A. Vessels pass through the Suez Canal in a continuous stream night and day, the canal being lit by powerful search lights. We have no recent figures as to the volume of the traffic but in 1904, 2,733 ships passed through the canal, with a tonnage of over eight million. The average time of passage is 18 hours. 9. How many kilowatts can a three-phase circuit of 7 strands of No. 6 wire cable transmit at 100,000 volts for a distance of 155 miles? and (10) what would be the amount of power lost in transmission? A. We cannot make this calculation without making you a charge. The subject occupies 100 pages in the Standard Electrical Engineer's Handbook, which we can send you for $4. We do not encourage lists of questions so long as the foregoing, which are no less trouble than the "examination papers" prohibited in our "Hints to Correspondents." Most of these questions could be answered from a dictionary and some from a school reader. The above are answered only on account of inquirer's address being probably remote from a library.

NEW BOOKS, ETC.

The Bullet's Flight From Powder to Target. By Franklin W. Mann. Milford, Mass.: Published by Munn & Co., 1909. Large 8vo.; pp. 384. Profusely illustrated. Price, $4.

This work deals with a subject the literature of which is not commensurate with its importance or interest, and it possesses unusual value, not only because it furnishes a large amount of information of a very practical kind, but because this information is the result of a practical experience on the part of the writer extending over a period of thirty-eight years. The author tells us that the results of his experiments as here given have been persistently and laboriously worked out with an earnest desire to assist his fellow craftsmen. In view of the fact that conjecturing and theorizing have been so prevalent in rifle literature, the work has been kept free from speculations, except where they have either been proved to be false or have been fully substantiated by recorded experiments. The first impression on glancing through this work is of the extraordinary number and value of the illustrations, which must average at least one to every two pages. Most of these are photographic reproductions of the results of actual tests. Particularly fine are those made of bullets before and after firing, and the large number of illustrations of carefully indexed targets against which firing tests had been made. The work has also been enriched with lettered line cuts and with half-tone engravings of various experiments that throw light upon the questions discussed. Every page is full of interest and information for the rifle enthusiast. There is a full discussion of various kinds of rifles; of the effect of difference of length, of variations of rifling, etc., as well as of curious experiments, such as that of venting the barrel near the muzzle. An idea of the contents may be gathered from a few of the subjects treated, such as the Personal Element vs. Mechanical Rifle Shooting; Utility of Vented Barrels; High-Pressure Sharpshooting Powder; Telescope Mounts; Ruined Rifle Bores vs. Smokeless Powder vs. Primers; Accurate Ammunition Difficulties; Flight of Bullets, Gyration and Oscillation; Motions Executed by Normal Flying Bullets; Determining Rifle Twists; Kinetics of Spin, etc. In many respects this work is unique in the literature that has been published on this subject. It is thoroughly practical, and will be found to be of very real value to those who are engaged in a study of the ballistics of the rifle with a view to improving the all-round efficiency of that weapon.

Trigonometrische Längenbestimmung, Geodätischer Grundlinien. Von A. Tichy, Inspektor der K. K. Osterreichischen Staatsbahnen. Wien: Eigentum und Verlag des Osterreichischen Ingenieur und Architekten-Vereines, 1909.

The author of this monograph was commissioned in 1900 to devise a method of plotting the four great Alpine tunnels. He was instructed to abandon the conventional method of employing definite triangulation data, and to evolve an entirely new method based upon original data, the reason being that the older method was inapplicable for plotting tunnel lines in so mountainous a country. At that time the author was compelled to adopt a system of optical measurement based upon a qualified logarithmical method which seemed best adapted for the purpose. At the same time he developed another conception, and carried it out in practice, a method which would seem to be somewhat more exact than the qualified optical method in question. It was not until 1904 that this new measuring instrument was completed and actually employed. It is this instrument and its manner of use which Herr Tichy has thoroughly described in this monograph.

The South Americans. By Albert Hale. Indianapolis: Bobbs-Merrill Company, 1908. 360 pp.; 8vo.; fully illustrated with maps and photographs. Price, $2.50.

To anyone contemplating a pleasure trip to South America or around the coast of our sister continent, the perusal of this book can be confidently recommended as providing pleasurable instruction, which will greatly add to the reader's intelligent interest in sights to be seen. To exporters or others having trade relations with the South American republics desiring to improve the efficiency of their sales service by an intelligent sympathy with their customers the book should be equally valuable. The author says that he writes "with a North American pen but looking through South American eyes," but we should say rather that he looks through North American eyes carefully purged of any prejudicial point of view and with an admirable determination not to overlook the good points of his subject. Such a work, if it reaches the readers who most need it, cannot fail to promote the cause of international amity, without which the industrial development by foreign capital of immense areas of great productive possibilities cannot well progress; and no reader, even if prejudiced, can fail to be repaid for its perusal by the interest of the story. After some introductory notes in lighter vein but none the less interesting the author takes up in turn the geography, the history, the government and the people and present conditions of Argentina, proceeding to discuss in the same order the same topics with regard to Uruguay, Brazil, and Venezuela in turn. He continues with a general review of trade conditions and concludes with an admirable chapter on the Monroe doctrine. It is a suggestive comment on the influence of democracy that in discussing the weaknesses which all nations possess, the author refers most frequently, as traits of South America in general and Venezuela in particular, to those marks toward which the shafts of foreign critics of the United States are most frequently directed—bombastic oratory and "graft." To offset this we are told that gallant manners on the part of the lower orders from the beggar upward co-exist with "an aristocracy of wealth, education, and blood, usually all three," of neither of which we are frequently accused by visiting critics.

The American Handy Book of the Brewing, Malting, and Auxiliary Trades. By Robert Wahl and Max Henius, Ph.DD. Two vols. Chicago: Wahl-Henius Institute of Fermentology, 1908. 1,600 pp.; 12mo.; ill.; tables; etc.

Most trades have their handbooks nowadays, engineering being blessed with the largest number, but though this is the only one we know of in reference to brewing and malting, there is no industry which has a more thorough handbook. It aims to be a pocket encyclopædia, by reference to which brewer, maltster, cooler, bottler, or anyone connected with the commercial end of brewing may find the answer to any question which may come up in his work without his having to wade through bulky textbooks and peruse quantities of information in search of a single item. This requires the condensation into the smallest compass of essential facts from a broad range of information covering arithmetic, algebra, physics, chemistry, rudiments of machinery, steam engines, and refrigeration, as well as practical details of brewing and malting, casking, bottling, and shipping; but so success-

fully was the work done, that the first edition was exhausted in a year, and the second larger one in a few years more. The present third edition includes the improvements in brewing and malthouse operations due to the recent developments of electrical machinery, and gives a new chapter on electricity and magnetism. A new chapter is also included to cover recent botanical studies of barley, and the chapters on Mechanics and Power are rewritten, while only the tables have been retained from the chapters on Arithmetic and Algebra. The printing and general appearance have been much improved by division of the work into two volumes on better paper, the division being so arranged that few individuals in the brewing trades requiring the volume as a pocket companion will not find all they need, each for his particular specialty, in one volume. Of the allied processes discussed, refrigeration is better treated than in any pocket book we know of the same scope, and in a general way the work retains its character as a model handbook in its line.

DYNAMO, MOTOR, AND SWITCHBOARD CIRCUITS FOR ELECTRICAL ENGINEERS. By William Rushton Bowker. Second Edition. New York: D. Van Nostrand & Co., 1908. 8vo.; pp. 168; 130 figures. Price, $2.50.

The special object of this book is to present the subjects indicated by the title in a non-mathematical way, and as viewed from the practical standpoint. The author originally had in view the needs of the student preparing for the City and Guilds of London examinations in electrical engineering, and for this reason the work covers certain important sections of the Syllabus of the Ordinary and Honor Grades. However, this would make it no less valuable to the American student and practical engineer. In the present second edition two new sections have been added to furnish information in regard to central-station layouts. This renders the book particularly useful to central-station engineers and their assistants.

ELEKTRISCHE UHREN. Von Dr. A. Tobler, Dozent am Eidg. Polytechnikum in Zürich. Zweite Auflage, bearbeitet von Johannes Zacharias, Ingenieur, Mit 120 Abbildungen.

Since the publication of the first edition of Zacharias' "Electrical Clocks," the technique of the art has advanced to such a degree that a new edition seemed necessary. Wall clocks, and even timepieces in which great accuracy is demanded, are now electrically driven. In order that the art might be fully covered it was necessary to omit electrical firm alarm apparatus which found a place in the first edition. In this volume, therefore, only electrical timepieces are described. In attacking the subject, the author has described first, electrical installations which are necessary to drive a clock train. He then passes to time telegraphs, recording apparatus, and finally discusses important inventions which have made their appearance in the last thirty years. Inasmuch as the data here presented have been collected largely as a result of personal intercourse with manufacturers, engineers and scientists, the book may be taken as an authoritative presentation of an interesting technical subject.

PRACTICAL CONCRETE BLOCK MAKING. By Charles Palliser. New York: Industrial Publishing Company, 1908. 75 pp.; 12mo.; fully ill. Price, 50 cents.

The author, though obviously somewhat prejudiced in favor of the concrete block from his years of successful experience in its manufacture, tells a convincing story going to show that much of the criticism applied to the block should more properly belong to the careless maker or the inadequate machine. The book is well written in clear, simple language, without any chemical or engineering formulæ, and explaining every technical term, so that any workman starting in the business for himself can understand every step of the operation of making good substantial concrete blocks. The author tells how to select molds and materials, how to find the right proportions of cement and aggregate, how to mix, make, and cure, and how to place the bricks in the wall, giving various methods of facing and practical hints on how to secure the best architectural effects.

THE PROBLEM OF AGE, GROWTH, AND DEATH. By Charles S. Minot, D.Sc. New York: G. P. Putnam's Sons, 1908. 280 pp.; 8vo.; ill. Price, $2.50.

Whereas this book deals with a series of biological problems, it is, as the author points out, essentially a study of a single phenomenon, the increase in the amount of protoplasm. The increase to be considered is not that distributed through the system of the growing organism, but that which occurs within the limits of a single cell. The ultimate object of all biology being the discovery of the nature of life, the author considered that the most promising opportunities for the attack of the problem lay in the study of observable changes affected by age in organisms, senescence being a qualification of living matter having no apparent parallel in the inorganic. It is an essential feature of life and therefore a useful guide to the proper aim of biology. If genius is properly defined as "an infinite capacity for taking pains" Mr. Minot's study may certainly be described as a work of genius. He explains the limitations under which he has labored, the great number of interesting by-paths revealed as he started along his chosen road which his other occupation prevented his following, and does not at all claim his book to be a complete treatise on the subject, but so far as it goes and within the limits indicated by the title the work is admirably thorough. For a number of reasons convincingly explained by the author but too long to be quoted, the guinea-pig was selected as the most convenient organism in which to study growth as a function of age typical of its phenomena in any other organism, and some idea of the painstaking nature of the study will be obtained from the statement that for long periods as many as one hundred guinea-pigs, kept under the most carefully co-ordinated conditions, were personally examined twice every day. The results obtained are by no means confined to guinea-pigs, the evidence obtained from them being compared with changes in the higher animals including man. The language is clear and to the point and free as far as possible from Greek and Latin scientific terms, making it as interesting to the layman as to the biological student.

LA SYNTHESE DES PIERRES PRECIEUSES. Par Jacques Boyer. Paris: Gauthier-Villars, Imprimeur Librairie du Bureau des Longitudes de l'Ecole Polytechnique, 1909.

This little monograph on the synthetic production of precious stones is one of the first attempts which we have seen in book form to present a general review of the manufacture of gems artificially. Mr. Boyer gives an historical *résumé* and discusses in detail the processes of Verneuil, Paquier, Paris, Moissan, and Hannay. The little book gives one a fairly good popular idea of the work which is being done in a comparatively new field of physical chemistry.

HYDRAULIC TABLES. Second edition, revised and enlarged. New York: John Wiley & Sons, 1909. 104 pp.; 8vo. Price, $1.50.

This new edition contains little alteration beyond correction of errors discovered in the first edition and could hardly contain any improvement, being already well known as the most complete set of hydraulic tables published. An interesting explanation of the derivation of the formula known by the name of the authors is given, and a table of discharge from high weirs is added in response to requests from users of the former edition.

AUTOMATIC SCREW MACHINES AND THEIR TOOLS. By C. L. Goodrich, Screw Machine Expert Pratt & Whitney Company, and F. A. Stanley, Associate Editor of the American Machinist. New York: Hill Publishing Company, 505 Pearl Street; 6 Bouverie Street, London, E. C. American Machinist, The Engineering and Mining Journal, Power and The Engineer. Octavo; pp. 255; illustrated. Price, $2 net.

The subject matter of this book naturally divides itself into two parts. One devoted to various types of machines and their construction, general tool equipments, methods of camming, etc., and the other to tools in detail and containing specific information on making and using these tools, the speeds and feeds at which they should be operated, and other particulars which will be of service to mechanics interested in screw machine work. In the chapters on camming, the book illustrates and describes in detail the different makes of automatic screw machines and turret lathes, including single-spindle, double and multiple spinning machines, magazine feed, and other types of machines for finishing castings, forging, etc., with full tables of speeds and feeds for different kinds of stock and for all classes of cutting tools.

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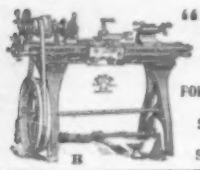

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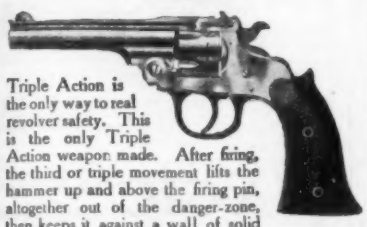

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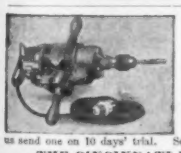

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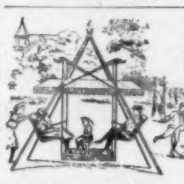

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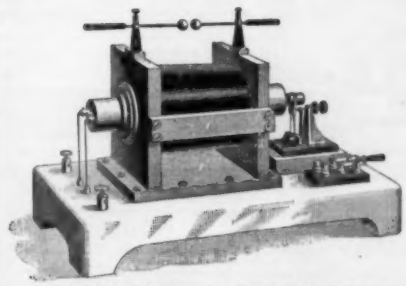

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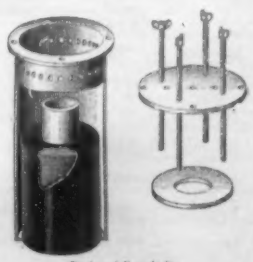

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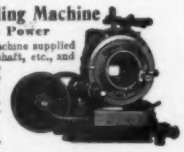

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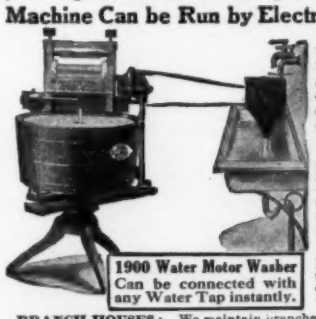

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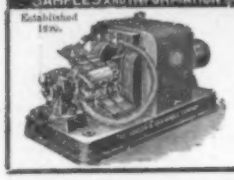

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